ANSWERS & EXPLANATIONS
GENERAL STUDIES (P) TEST – 3807 (2023)

Q 1.C

- Ship hulls are under continuous attack by shipworm and various marine weeds, all of which have some adverse effect on the ship, be it structurally, as in the case of the worm, or affecting speed and handling in the case of the weeds.
- Copper sheathing is the method for protecting the hull of a wooden vessel from attack by shipworm, barnacles and other marine growth through the use of copper plates affixed to the surface of the hull, below the waterline.
- **Copper has anti-bacterial properties and prevents the growth of bacteria on the ship and prevents it decay.** While other functions like providing strength etc. can be done by other metals too but preventing the growth of bacteria is the one that makes it unique for the use in boats.
- **Hence option (c) is the correct answer.**

Q 2.D

- An **autotroph** is an organism that can **produce its own food using light, water, carbon dioxide, or other chemicals.** Carbon and energy requirements of the autotrophic organism are fulfilled by photosynthesis.
- **Photosynthesis is the process by which autotrophs take in substances from the outside and convert them into stored forms of energy.** This material is taken in the form of carbon dioxide and water which is converted into carbohydrates in the presence of sunlight and chlorophyll. Carbohydrates are utilised for providing energy to the plant.
- **The carbohydrates which are not used immediately are stored in the form of starch, which serves as the internal energy reserve to be used as and when required by the plant.**
- **The following events occur during this process of photosynthesis –**
  - **Absorption of light energy by chlorophyll.**
  - **Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.**
  - **Reduction of carbon dioxide to carbohydrates.**
- These steps need not take place one after the other immediately. For example, desert plants take up carbon dioxide at night and prepare an intermediate which is acted upon by the energy absorbed by the chlorophyll during the day.
- **Hence option (d) is the correct answer.**

Q 3.A

- Tyndall effect is the phenomenon in which the particles in a colloid scatter the beams of light that are directed at them. This effect is exhibited by all colloidal solutions and some very fine suspensions. Therefore, it can be used to verify if a given solution is a colloid. The intensity of scattered light depends on the density of the colloidal particles as well as the frequency of the incident light.
- When a beam of light passes through a colloid, the colloidal particles present in the solution do not allow the beam to completely pass through. The light collides with the colloidal particles and is scattered (it deviates from its normal trajectory, which is a straight line). This scattering makes the path of the light beam visible, as illustrated below.
- **Examples of the Tyndall Effect**
  - Milk is a colloid that contains globules of fat and protein. When a beam of light is directed at a glass of milk, the light is scattered. This is a great example of the Tyndall effect.

www.freeupscmaterials.org

- When a torch is switched on in a foggy environment, the path of the light becomes visible. In this scenario, the water droplets in the fog are responsible for the light scattering.
- Opalescent glass has a bluish appearance when viewed from the side. However, orange-colored light emerges when light is shined through the glass.
- When sunlight passes through a canopy of a dense forest. Tiny water droplets in the mist scatter light. The color of the scattered light depends on the size of the scattering particles. **Hence option (a) is the correct answer.**

- **Rayleigh scattering, named after the 19th-century British physicist Lord Rayleigh,** is the predominantly elastic scattering of light or other electromagnetic radiation by particles much smaller than the wavelength of the radiation.
- **Compton scattering, discovered by Arthur Holly Compton,** is the scattering of a high-frequency photon after an interaction with a charged particle, usually an electron. If it results in a decrease in the energy of the photon, it is called the Compton effect.
- **In physics, total internal reflection** is the phenomenon in which waves arriving at the interface from one medium to another are not refracted into the second medium but completely reflected back into the first medium.

Q 4.C

- Deficiency of one or more nutrients can cause diseases or disorders in our body. Diseases that occur due to lack of nutrients over a long period are called deficiency diseases. Deficiency of different vitamins and minerals may also result in certain diseases or disorders.
- In its more severe forms, **vitamin A deficiency contributes to blindness** by making the cornea very dry, thus damaging the retina and cornea. **Hence pair 1 is correctly matched.**
- **Scurvy is the most prominent disease linked to Vitamin C deficiency**. It denotes a heavy lack of vitamin C in the diet. Scurvy is the most prominent disease linked to Vitamin C deficiency. **Hence pair 2 is not correctly matched.**
- Vitamin D deficiency can lead to a loss of bone density, which can contribute to osteoporosis and fractures (broken bones). Severe vitamin D deficiency can also lead to other diseases. In children, it can cause rickets. Rickets is a rare disease that causes the bones to become soft and bend.

Table 2.3 – Some diseases/disorders caused by deficiency of vitamins and minerals

Vitamin/ Mineral	Deficiency disease/disorder	Symptoms
Vitamin A	Loss of vision	Poor vision, loss of vision in darkness (night), sometimes complete loss of vision
Vitamin B1	Beriberi	Weak muscles and very little energy to work
Vitamin C	Scurvy	Bleeding gums, wounds take longer time to heal
Vitamin D	Rickets	Bones become soft and bent
Calcium	Bone and tooth decay	Weak bones, tooth decay
Iodine	Goiter	Glands in the neck appear swollen, mental disability in children
Iron	Anaemia	Weakness

- Anaemia is a condition in which blood lacks adequate healthy red blood cells. Red blood cells carry oxygen to the body's tissues. I**ron deficiency anaemia is due to insufficient iron. Hence pair 3 is correctly matched.**
- Goiter is a condition where your thyroid gland grows larger. **Iodine deficiency is the most common cause of goiter in the world. Hence pair 4 is correctly matched.**

Q 5.B

- **Voltmeter:**
  - Voltmeter which is also known as a voltage meter is an instrument that **measures the voltage or potential difference between two points** of an electronic or electrical circuit. Usually, the voltmeter is used for Alternating Current (AC) circuits or Direct Current (DC) circuits. Alternatively, Radio Frequency (RF) voltage can also be measured by specialized voltmeters.

- In order to measure a device's voltage, **a voltmeter is connected in parallel to a device.** This setup is important as objects in parallel usually tend to experience the same potential difference. It is connected in parallel with the circuit mainly because the same voltage drop occurs across it. **Hence statement 1 is not correct.**
- A **voltmeter also has high internal resistance.** This is done mainly because it is used in measuring the potential difference between the two points of the circuit. As such the current of the measuring device remains the same. In other words, the high resistance of the voltmeter will impede the flow of current through it. This allows the device to take correct readings of the voltage. **Hence statement 2 is correct.**

Q 6.C

- **Recently, SEBI has allowed Alternative Investment Funds (AIFs) to participate in Credit Default Swaps (CDS).** AIF refers to any privately pooled investment fund, (whether from Indian or foreign sources), in form of a trust or a company or a body corporate, or a Limited Liability Partnership (LLP).
- **CDS is a financial derivative that allows an investor to swap or offset their credit risk with that of another investor. To swap the risk of default, the lender buys a CDS from another investor who agrees to reimburse them if the borrower defaults. Hence, statement 1 is correct.**
- **Most CDS contracts are maintained via an ongoing premium payment similar to the regular premiums due on an insurance policy.** A lender who is worried about a borrower defaulting on a loan often uses a CDS to offset or swap that risk.
- Credit default swaps **played a role in both the 2008 Great Recession and the 2010 European Sovereign Debt Crisis.**
- **CDS is used for speculation, hedging, or as a form of arbitrage. Hence, statement 2 is correct.**
- **Speculation**
  - Because swaps are traded, they naturally have fluctuating market values that a CDS trader can profit from. Investors buy and sell CDSs from each other, attempting to profit from the difference in prices.
- **Hedging**
  - A credit default swap by itself is a form of hedging. A bank might purchase a CDS to hedge against the risk of the borrower defaulting. Insurance companies, pension funds, and other securities holders can purchase CDSs to hedge credit risk.
- **Arbitrage**
  - Arbitrage generally involves purchasing a security in one market and selling it in another. CDSs can be used in arbitrage—an investor can purchase a bond in one market, then buy a CDS on the same reference entity on the CDS market.

Q 7.C

- **The enzyme-linked immunosorbent assay (ELISA) is an immunological assay commonly used to measure antibodies, antigens, proteins and glycoproteins in biological samples.** Some examples include: diagnosis of HIV infection, pregnancy tests, and measurement of cytokines or soluble receptors in cell supernatant or serum.
- **Antibodies are blood proteins produced in response to a specific antigen. ELISA helps to examine the presence of antibodies in the body, in case of certain infectious diseases.**
- **Principle of ELISA:** ELISA works on the principle that specific antibodies bind the target antigen and detect the presence and quantity of antigens binding. **Performing an ELISA involves at least one antibody with specificity for a particular antigen.** In order to increase the sensitivity and precision of the assay, the plate must be coated with antibodies with high affinity. ELISA can provide a useful measurement of antigen-antibody concentration. **Hence, statement 1 is correct.**
- **Indian Council of Medical Research (ICMR)-National Institute of Virology (NIV) at Pune has developed and validated the indigenous IgG ELISA test "COVID KAVACH ELISA" for antibody detection for COVID-19.** It is an IgG Elisa-based test. This means that the test will be done to detect the Immunoglobulin G (IgG) antibody.
- The body produces Immunoglobulin M (IgM) and IgG antibodies to fight against a pathogen. The IgM antibodies are produced in four-seven days after pathogens enter the body while the IgG antibodies are produced between 10-14 days of the pathogen's appearance. **If the IgG antibody is detected, it can be concluded that the person was exposed to SARS-CoV-2. Hence, statement 2 is correct.**

Q 8.C

- Plastics are categorized into - thermoplastics and thermosetting plastics. Plastic which gets deformed easily on heating and can be bent easily are known as thermoplastics, for example: PVCs and Polythene. On the

other hand, there are some plastics which **when moulded once, can not be softened by heating** are called **thermosetting plastics**, examples are **bakelite and melamine. Hence, statement 1 is correct.**

- Bakelite is the commercial name for the polymer obtained by the polymerization of phenol and formaldehyde. It has **low electrical conductivity and high heat resistance.** Therefore it is a poor conductor of heat and electricity. It can be used in manufacturing **electrical switches, machine parts of electrical systems, handles of various utensils, etc. Hence, statement 2 is not correct and statement 3 is correct.**

Q 9.B

- A **quark** is a type of elementary particle and a fundamental constituent of matter. Quarks combine to form composite particles called **hadrons, the most stable of which are protons and neutrons, the components of atomic nuclei.**
- In particle physics, a **hadron** is a composite subatomic particle made of two or more quarks held together by a strong interaction. They are analogous to molecules that are held together by the electric force.
- Quarks are considered to be point-like entities, with zero sizes. As of 2014, experimental evidence indicates they are no bigger than 10−4 times the size of a proton, i.e. less than 10−19 meters.
- An **atom is a particle of matter** that uniquely defines a chemical element. An atom consists of a central nucleus that is surrounded by one or more negatively charged electrons. The nucleus is positively charged and contains one or more relatively heavy particles known as protons and neutrons.
- Thus, atoms consist of hadrons and hadrons are made up of quarks. **Hence option (b) is the correct answer.**

Q 10.A

- Silver articles, when exposed to air become black after some time. This is because the **silver metal reacts with sulphur present in the atmosphere and forms silver sulphide.** Thus, a layer of silver sulphide is formed on the surface of silver articles, because of which they appear dull and black.
- **Hence, option (a) is the correct answer.**

Q 11.C

- **Recent Context: The annual status of education report (ASER) 2022 has been released by NGO Pratham.**
- **Annual Status of Education Report (ASER), India's largest NGO-run annual survey, has been conducted by Pratham since 2005 to provide estimates of children's schooling status and their ability to read simple text and do basic arithmetic and evaluate the relevance and impact of its programs. Hence statement 1 is correct.**
- Findings are disseminated at national, state, district, and village levels, and influence education policies at both state and central levels.
- ASER Survey is a **household survey rather than a school-based survey. Hence statement 2 is not correct.**
  - It consists of one-on-one oral assessments.
  - It is aimed at a r**epresentative sample of all children (whether in school or out of school)**.
  - It is **limited to rural areas of the country. Hence statement 3 is correct.**
  - It is also the only annual source of information on children's learning outcomes available in India.
- **ASER 2022 is the first field-based 'basic' nationwide ASER since 2018.** In ASER 2022, children in the age group of 3 to 16 years were surveyed to record their schooling status and assess their basic reading and arithmetic skills.
- **The Key Findings are:**
  - **Government school enrolment: The proportion of children (aged 6 to 14) enrolled in government schools increased sharply from 65.6% in 2018 to 72.9% in 2022. Hence, statement 1 is not correct.**
  - Nationally, the proportion of children in Standard I-VIII taking paid private tuition classes increased from 26.4% in 2018 to 30.5% in 2022.
  - **The enrolment rate for the 6 to 14 age group has been above 95% for the past 15 years. Despite school closures during the pandemic, overall enrolment figures have increased from 97.2% in 2018 to 98.4% in 2022. Hence, statement 2 is not correct.**
  - 2022 was the first time when the percentage of children currently not enrolled in schools dropped to 2 per cent or below. Even after prolonged school closures during the pandemic period, proportion of children not enrolled in school continued to decline between 2018 and 2022.
  - As per the ASER 2022, **there has been a record high in the number of enrollment,** reaching the highest level since the introduction of the Right to Education Act in 2009. During the pandemic there was a spike in dropout rates, which was temporary.

Q 12.D

- An indicator is a substance which changes its colour, odour, properties, etc. when it comes in contact with an acid or a base.
- **Litmus** is a natural indicator. It is a purple dye which is extracted from a type of plant called 'lichen'. **Blue litmus paper turns red** if the substance is acidic.
- **Turmeric** is an acid-base indicator. When it reacts with bases, it changes color to deep red. This red form of the indicator can **change back to yellow when acids are added.**
- **Methyl orange** is a popular pH indicator that is used in titration. The **colour of the solution turns red** when methyl orange is used as an indicator of acid.
- **Vanilla extract** has a characteristic pleasant smell. If a basic solution is added to vanilla extract, then we cannot detect the characteristic smell of vanilla extract. An **acidic solution does not destroy the smell of vanilla extract.** This can be used as a test for acids and bases by a visually impaired student.
- **Hence, option (d) is the correct answer.**

Q 13.A

- **The resistivity of alloy:**
  - The resistivity of any substance can be defined as the **electrical resistance of a conductor of a unit cross-sectional area and a unit length.** Every material has some amount of resistivity. Some have high resistivity and some have low resistivity. The more the resistivity, the less the amount of current carrying capacity by the material and the lesser the resistivity more is the current carrying capacity of the material.
  - Higher resistivity substances are insulators and lower resistivity materials are conductors.
  - **Alloys have higher resistivity** than their constituent metals because of the following reasons:
    - Alloys have high melting and boiling points.
    - **In alloys, higher resistivity is caused by** the additional scattering of electrons known as alloy scattering. **Hence statement 1 is correct.**
    - Burning or combustion always involves oxygen. Alloys do not get burnt (or get oxidized) easily. **Hence statement 2 is not correct.**
    - In fact, alloys have better properties than their constituent metals.
- Examples of alloys are Steel, Nichrome, Bronze, Brass, Duralumin, and solder. **Hence statement 3 is not correct.**

Q 14.C

- **An exothermic reaction** is a chemical reaction that **involves the release of energy in the form of heat or light.** Thus in an exothermic reaction, energy is transferred into the surroundings rather than taking energy from the surroundings as in an endothermic reaction.
- **Formation of clouds** is due to the condensation of water vapour. As **heat is released** during the conversion of gas into a liquid and from liquid to solid (snow), it is an **exothermic reaction.**
- **When liquid water is heated that means heat is taken. So, it is an endothermic reaction. Latent heat of vaporization makes heat content in the stem greater than in liquid water at 1000 degree celcius.**
- The process of **rusting iron is an exothermic reaction.** It's because the rust-producing process between iron and damp air releases a lot of heat. However, the reaction normally takes place at such a sluggish rate that the release of heat is barely apparent.
- **Hence, option (c) is the correct answer.**

Q 15.C

- R.H. Whittaker (1969) proposed a Five Kingdom Classification. The kingdoms defined by him were named Monera, Protista, Fungi, Plantae and Animalia. The main criteria for classification used by him include cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.

www.freeiascmaterials.org

TABLE 2.1 Characteristics of the Five Kingdoms

Characters	Five Kingdoms				
	Monera	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellulosic (Polysaccharide + amino acid)	Present in some	Present (without cellulose)	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multiceullar/ loose tissue	Tissue/ organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and Heterotrophic (saprophytic/parasitic)	Autotrophic (Photosynthetic) and Heterotrophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosynthetic)	Heterotrophic (Holozoic/ Saprophytic etc.)

From the above figure, statement 1 is correct.

- **Bacteria are the sole members of the Kingdom Monera.** They are the most abundant micro-organisms. Bacteria occur almost everywhere. Hundreds of bacteria are present in a handful of soil. They also live in extreme habitats such as hot springs, deserts, snow and deep oceans where very few other life forms can survive. **Hence statement 2 is correct.**
- All single-celled eukaryotes are placed under Protista, but the boundaries of this kingdom are not well defined. Members of Protista are primarily aquatic. This kingdom forms a link with the others dealing with plants, animals and fungi. Being eukaryotes, the protistan cell body contains a well defined nucleus and other membrane-bound organelles. Some have flagella or cilia. Protists reproduce asexually and sexually by a process involving cell fusion and zygote formation.

Q 16.D

- In the five kingdom classification of Whittaker there is no mention of some acellular organisms like viruses and viroids, and lichens. Viruses did not find a place in classification since they are not truly 'living', if we understand living as those organisms that have a cell structure. Viruses are non-cellular organisms that are characterised by having an inert crystalline structure outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves, killing the host.
- In addition to proteins, viruses also contain genetic material, that could be either RNA or DNA. Leuko virus contains both DNA and RNA. **Hence statement 1 is not correct.**
- A virus is a nucleoprotein and the genetic material is infectious. In general, viruses that infect plants have single stranded RNA and viruses that infect animals have either single or double stranded RNA or double stranded DNA. **Bacterial viruses or bacteriophages (viruses that infect the bacteria) are usually double stranded DNA viruses. Hence statement 2 is not correct.**
- Viruses cause diseases like mumps, small pox, herpes and influenza. AIDS in humans is also caused by a virus. In plants, the symptoms can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

Q 17.B

- The basic needs of all living organisms are essentially the same. They require macromolecules, such as carbohydrates, proteins and fats, and water and minerals for their growth and development.
- **The criteria for essentiality of an element are given below:**
  - The element must be absolutely necessary for supporting normal growth and reproduction. In the absence of the element the plants do not complete their life cycle or set the seeds.
  - The requirement of the element must be specific and not replaceable by another element. In other words, deficiency of any one element cannot be met by supplying some other element.
  - The element must be directly involved in the metabolism of the plant.
- Only a few elements have been found to be absolutely essential for plant growth and metabolism. These elements are further divided into two broad categories based on their quantitative requirements.

- Macronutrients are generally present in plant tissues in large amounts. The macronutrients include Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorous, Sulphur, Potassium, Calcium and Magnesium.
- **Micronutrients or trace elements, are needed in very small amounts. These include Iron, Manganese, Copper, Molybdenum, Zinc, Boron, Chlorine and Nickel. Hence, option (b) is the correct answer.**
- In addition to the 17 essential elements named above, there are some beneficial elements such as Sodium, Silicon, Cobalt and Selenium. They are required by higher plants.
- **Role of Macro and Micro-nutrients:** Essential elements perform several functions. They participate in various metabolic processes in the plant cells such as permeability of cell membrane, maintenance of osmotic concentration of cell sap, electron- transport systems, buffering action, enzymatic activity and act as major constituents of macromolecules and co-enzymes.

Q 18.B

- **Recently, the Prime Minister of India flagged off the world's longest river cruise from Varanasi to Dibrugarh via Bangladesh carrying 32 Swiss tourists which will reach Dibrugarh after 50 days covering more than 3,200 km.**
- It will cost $300 a day per passenger and this fare is same for Indians and foreigners.
- **MV Ganga Vilas, the privately-operated luxurious three-deck cruise ship** measuring 62 metres in length and 12 metres in width.
- **Hence option (b) is the correct answer.**

Q 19.B

- **Recent Context:** The Bihar government recently launched the caste survey which aims to compile data on each family digitally through a mobile application from the panchayat to the district level.
  - However, pleas were submitted to quash the notification on the ground that the caste-based census "violated the basic structure of the Constitution"
  - Supreme Court refused to entertain the petitions and asked the petitioners to approach the high court.
- **About Caste Census**
  - The caste census is the caste-wise tabulation of the population in the census exercise.
  - **The first census in India began in 1872 and the periodic count in 1881 under British rule. Since then, the data on caste was always included, though only till 1931. Hence statement 1 is not correct.**
  - Ever since independence, the Census had only the data related to SC and ST populations.
  - **The caste census is under the administrative control of the Ministry of Home Affairs. Hence statement 2 is correct.**
  - Earlier in 2011 attempt was made to Caste Census by conducting the Socio-Economic and Caste Census (SECC). Rohini Commission was another attempt at categorization within OBCs for better-targeted service delivery.

Q 20.D

- The human eye is like a camera. **Its lens system forms an image on a light-sensitive screen called the retina. Hence pair 3 is correctly matched.**
- Light enters the eye through a thin membrane called the cornea. It forms the transparent bulge on the front surface of the eyeball as shown in fig. The eyeball is approximately spherical in shape with a diameter of about 2.3 cm. **Most of the refraction of the light rays entering the eye occurs at the outer surface of the cornea.** The crystalline lens merely provides the finer adjustment of the focal length required to focus objects at different distances on the retina. **Hence pair 1 is correctly matched.**
- The structure behind the cornea is called Iris. Iris is a dark muscular diaphragm that controls the size of the pupil.
- T**he pupil regulates and controls the amount of light entering eye. Hence pair w is correctly matched.**

Q 21.A

- An RNA vaccine is when a vaccine is made up of messenger RNA that will cause the body's immune system to respond to a particular virus. A DNA vaccine is when a vaccine consists of the DNA of a pathogen that will trigger an immune response.
- **RNA Vaccines:** RNA vaccines are **derived from the mRNA of viruses,** via a process of genetic engineering. **The RNA vaccine is carried in the form of a liquid nanoparticle that consists of lipids.**
- **The idea behind an RNA vaccine is to trigger an immune response in which T lymphocytes are activated and a response is mounted against the particular viral disease.** The mRNA sequence is that

which codes for an antigen of the illness; an antigen is a protein that the immune system will then recognize as foreign. Antibodies will then be manufactured by the body in response to this antigen.

- **Advantages: The genetic code is already in a transcribed form for protein synthesis in the case of these vaccines. RNA vaccines are also believed by many scientists to be less risky than DNA vaccines since they would not affect the host's DNA or even have to enter the nucleus of a host cell because the mRNA has already been formed. This also means the process of making antibodies is faster. Hence, statement 2 is not correct.**
- **Disadvantages:** The technology is fairly new and relies on nanotechnology, and so far none of these have been approved by the FDA for use in people. A further disadvantage is that since only a part of the viral mRNA can be used, the immune response that is activated may not be very strong. This would mean a person would need to get boosters every so often to maintain a high level of immunity. **RNA degradation is a concern and thus more engineering is needed with substances added to protect the RNA and allow storage. Comparatively, DNA vaccines are safe, easy, affordable to produce, and, unlike RNA vaccines, are stable at room temperature. Hence, statement 1 is correct.**
- **DNA vaccine:** It uses a **genetically altered plasmid which contains a piece of DNA from a virus in order to activate an immune response.** The vaccine is made using DNA from a virus, which codes for an antigen. The antigen then elicits the formation of antibodies by the person's body, which helps in the event of exposure to the virus that the particular DNA vaccine is designed for.
- **How it works:** A plasmid is used and modified to carry DNA of a virus. The plasmid is circular DNA from a prokaryotic bacterial cell, which is used in genetic engineering in molecular biology. The plasmid is inserted into the person when they are vaccinated.
- **Advantages:** Scientists have more knowledge and experience working with plasmids, so the process is somewhat easier compared with the nanotechnology involved in RNA vaccines. **DNA is also less susceptible to degradation and more stable in a lab setting compared with RNA.** This makes it easier and requires fewer steps for extraction and storage of the DNA compared with RNA.
- **Disadvantages:** Unlike an RNA vaccine, with which it may be confused, a DNA vaccine only contains DNA. This means an extra step is needed for making the antigen since mRNA has to first be transcribed in the nucleus from the DNA. This means it would take longer for the antibody response to be triggered.
- **DNA vaccines have been investigated for use to treat the following illnesses: malaria, typhoid, dengue, TB, and cancer. At the current time, DNA vaccines have not been approved for use in humans, although some have been approved for use in animals.**

Q 22.B

- **Magnetic field:**
  - The magnetic field is a quantity that has both direction and magnitude.
  - The direction of the magnetic field is taken to be the direction in which the north pole of the compass needle moves inside it. Therefore it is taken by convention that the field lines emerge from the north pole and merge at the south pole.
  - Inside the magnet, the direction of field lines is from its south pole to its north pole. Thus the magnetic field lines are closed curves. **Hence statement 1 is not correct.**
  - The relative strength of the magnetic field is shown by the degree of closeness of the field lines. The field is stronger, that is, the force acting on the pole of another magnet placed is greater where the field lines are crowded. **Hence statement 2 is correct.**
  - No two field lines are found to cross each other. If they did, it would mean that at the point of intersection, the compass needle would point in two directions, which is not possible. **Hence statement 3 is correct.**

Q 23.A

- **Bhopal Declaration was released after Think20 (T20) meeting, official engagement group of G20 which brings together leading think tanks and research centers worldwide.**
- **The importance of localization in achieving G-20 sustainable development goals** has been acknowledged in the Bhopal Declaration. Eminent speakers said that **triangular cooperation of government, society, and private organizations** is necessary to achieve this goal. All the prominent speakers also acknowledged that India is doing important work in triangular cooperation and we can change the global scenario with this Indian model. **The forum also covered India's crucial contribution to the containment of COVID-19 and its response to Russia-Ukraine war.**
- **Key highlights of Bhopal Declaration**

- **Appeal to all stakeholders to focus more on inclusive development care for welfare of every section of society in comparison to GDP. Hence, option (a) is the correct answer.**
- Encourage model of development led by women.
- Bridge the gap between North and South.
- **Promoting traditional medicine systems like AYUSH.**
- Encouraging value-oriented development in infrastructure development.
- **Work together to ensure the health for all.**

Q 24.C

- **Most plants have roots, stems and leaves. These are called the vegetative parts of a plant.** There are several ways by which plants produce their offspring. These are categorised into two types: (i) asexual, and (ii) sexual reproduction. **In asexual reproduction plants can give rise to new plants without seeds, whereas in sexual reproduction, new plants are obtained from seeds.**
- **Vegetative propagation**
  - It is a type of asexual reproduction in which **new plants are produced from roots, stems, leaves and buds.**
  - Since reproduction is through the vegetative parts of the plant, it is known as vegetative propagation.
  - **For example- potato, Ginger, Sweet potato. Hence pair 1 is correctly matched.**
- **Budding**
  - It is an asexual reproduction method in which a **new organism develops from a bud of an existing organism.**
  - Until the new organism matures, it remains attached to the parent organism.
  - The newly developed organism remains attached as it grows further. It is separated from the parent organism when it gets matured by leaving scar tissues behind.
  - **As this is asexual reproduction, the newly developed organism is a replica of the parent and is genetically identical. Bacteria, yeast, corals, flatworms, Jellyfish and sea anemones are some animal species which reproduce through budding.**
- **Fragmentation**
  - It is a form of asexual reproduction or cloning, where an organism is split into fragments.
  - Each of these fragments develops into mature, fully grown individuals that are clones of the original organism.
  - **When water and nutrients are available algae grow and multiply rapidly by fragmentation.**
  - **An alga breaks up into two or more fragments. These fragments or pieces grow into new individuals. This process continues and they cover a large area in a short period of time. Hence pair 3 is not correctly matched.**
- **Pollination**
  - Generally, pollen grains have a tough protective coat which prevents them from drying up.
  - **Since pollen grains are light, they can be carried by wind or water.**
  - Insects visit flowers and carry away pollen on their bodies. Some of the pollen lands on the stigma of a flower of the same kind.
  - The transfer of pollen from the anther to the stigma of a flower is called pollination.
  - **If the pollen lands on the stigma of the same flower or another flower of the same plant, it is called self-pollination. When the pollen of a flower lands on the stigma of a flower of a different plant of the same kind, it is called cross-pollination.**
  - **Tomatoes are self-pollinating, meaning they have flowers that contain both the male and female parts, so more than one plant is not needed for reproduction. Hence pair 2 is correctly matched.**

Q 25.A

- For plants, the soil is the nearest and richest source of raw materials like nitrogen, phosphorus and other minerals. The absorption of these substances therefore occurs through the part in contact with the soil, namely roots.
- Plants do not move, and plant bodies have a large proportion of dead cells in many tissues. As a result, plants have low energy needs, and can use relatively slow transport systems. The distances over which transport systems have to operate, however, can be very large in plants such as very tall trees. **Plant transport systems will move energy stores from leaves and raw materials from roots. These two pathways are constructed as independently organised conducting tubes, xylem and phloem.**
- The xylem and the phloem make up the vascular tissue of a plant and transports water, sugars, and other important substances around a plant. What is commonly referred to as **'sap' is indeed the substances that are being transported around a plant by its xylem and phloem.**

- **One, the xylem moves water and minerals obtained from the soil. The other, phloem transports products of photosynthesis from the leaves where they are synthesised to other parts of the plant.**
- The xylem is responsible for keeping a plant hydrated. **Xylem sap travels upwards and has to overcome serious gravitational forces to deliver water to a plant's upper extremities, especially in tall trees. Hence, statement 1 is not correct.**
- **The phloem carries important sugars, organic compounds, and minerals around a plant. Sap within the phloem simply travels by diffusion between cells and works its way from leaves down to the roots with help from gravity. Hence, statement 2 is not correct.**
- In xylem tissue, vessels and tracheids of the roots, stems and leaves are interconnected to form a continuous system of water-conducting channels reaching all parts of the plant. **At the roots, cells in contact with the soil actively take up ions. This creates a difference in the concentration of these ions between the root and the soil. Water, therefore, moves into the root from the soil to eliminate this difference.** This means that there is steady movement of water into root xylem, creating a column of water that is steadily pushed upwards.
- **Transpiration is a process that involves loss of water vapour through the stomata of plants. The loss of water vapour from the plant cools the plant down when the weather is very hot, and water from the stem and roots moves upwards or is 'pulled' into the leaves**.Transpiration also provides the driving force for transport of water and nutrients from roots to shoots. **Hence, statement 3 is correct.**

Q 26.A

- Valence electrons are the s and p electrons in the outermost shell. The electrons present in the inner shell are core electrons. Valance electrons are responsible for the interaction between atoms and the formation of chemical bonds.
- Only the electrons present in the outermost shell can participate in the formation of a chemical bond or a molecule. Such a type of electron is called a valence electron.
- The valence electrons are part of most chemical reactions because they contain more energy compared to the electrons present in inner orbits. Meanwhile, the number of valence electrons present also helps us determine a specific element's chemical properties, such as its valence or valency, and the formation of bonds with other elements. It also gives us an idea of how readily the atoms can form bonds, the number of unpaired electrons, and how many atoms can take part.
- **Hence, option (a) is the correct answer.**

Q 27.C

- **3D printing**
  - 3D printing is the automated process of building a three-dimensional object by adding material rather than taking material away (as in drilling or machining).
  - To create a 3D-printed object, one uses an "additive process". The three-dimensional object is created by laying down successive layers of material until the object is finished.
- **Limitations of 3D printing**
  - Although it is already deeply implemented in the world of prototyping, 3D printing is still some years away from having a breakthrough in the world of manufacturing. This breakthrough would allow 3D printing to spread from just prototyping, with the exception of select components already being manufactured by 3D printers, to be widely implemented in everyday manufacturing processes all over the world.
  - The main aspect keeping this from happening sooner is the relatively long time it takes to 3D print something that can just as well be manufactured using traditional methods (and we all know that time means money).
  - 3D printing is also limited by the size of the 3D printer. Although there are some pretty big units of 3D printing with cement, for example, high-quality and precision parts are limited to smaller machines which can also be very expensive depending on what they are designed to be capable of.
  - Another limitation is the fact that most 3D printers can only print in one material at a time. Multi-material 3D printers do exist, though, but are not very common yet.
- **The difference between 3D printing and additive manufacturing**
  - The term "3D printing" comes from the use of inkjet printer heads (in the first 3D printers) to deposit, either layer of UV-curable photopolymer resin or a binding material onto a layer of powder in a powder bed process. However, the term now universally encompasses all additive manufacturing technologies.
  - The more technical, or correct, way of referring to the automated process of building a 3D object from scratch using a digital file is "additive manufacturing".

- **The difference between 3D printing and 4D printing**
  - 4D printing is a subset of 3D printing. In "normal" 3D printing, the end product is static, unless some flexible material is used, and it is meant to stay in that form. 4D printing is a way of "programming" the material/object to change form or functionality when given the correct impulse.
  - 4D printing provides printed objects with the ability to change form or function with time according to various stimuli such as heat, water, current, or light. **Hence, statement 2 is correct.**
  - The essential difference between 4D printing and 3D printing is the addition of smart design or responsive materials that cause time-dependent deformations of objects.
  - 3D Printing is about repeating a 2D structure, layer by layer in a print path, from the bottom to the top, layer by layer until a 3D volume is created. **Hence, statement 1 is correct.**
  - **4D Printing is referred to as 3D printing transformed over time.** Thus, a fourth dimension is added: time. So, the big breakthrough of 4D Printing over 3D Printing technology is its ability to change shape over time.
  - A 4D-printed gripper grabs an object when the temperature is optimal. A 4D-printed object is printed just like any 3D-printed shape. The difference is that the 4D Printing technology uses programmable and advanced materials that perform a different functionality by adding hot water, light, or heat. That's why a non-living object can change its 3D shape and behavior over time.

Q 28.B

- **Recently, NASA's James Webb telescope has found a star formation (Called NGC 346) in a dynamic cluster that lies within Small Magellanic Cloud (SMC).**
- **Magellanic clouds are visible to the naked eye from southern hemisphere. But they cannot be observed from most northern latitudes. Hence statement 1 is correct.**
- **The Milky Way has a number of satellite galaxies, but the biggest one is the Large Magellanic Cloud. It is about 163,000 light-years away** and around 1/100th the size of the Milky Way. These companion galaxies were named for the Portuguese navigator Ferdinand Magellan, whose crew discovered them during the first voyage around the world (1519–22). **The Magellanic Clouds were recognized early in the 20th century as companion objects to the Milky Way Galaxy. When American astronomer Edwin Hubble established the extragalactic nature of what are now called galaxies, it became plain that the Magellanic Clouds had to be separate systems. Hence, statement 2 is not correct.**
- Unlike our spiral galaxy, this one lacks a clean spiral shape. Some scientists think that is because the Milky Way and other galaxies are pulling and warping it. **The Magellanic Clouds were formed at about the same time as the Milky Way Galaxy, approximately 13 billion years ago.** They are presently captured in orbits around the Milky Way Galaxy and have experienced several tidal encounters with each other and with the Galaxy. They contain numerous young stars and star clusters, as well as some much older stars.
- **The Magellanic Clouds serve as excellent laboratories for the study of very active stellar formation and evolution.** For example, the Tarantula Nebula (also called 30 Doradus) is an immense ionized-hydrogen region that contains many young, hot stars. The total mass of 30 Doradus is about one million solar masses, and its diameter is 550 light-years, making it the largest region of ionized gas in the entire Local Group of galaxies. **With the Hubble Space Telescope it is possible for astronomers to study the kinds of stars, star clusters, and nebulae that previously could be observed in great detail only in the Milky Way Galaxy. Hence, statement 3 is correct.**

Q 29.A

- Plant growth regulators (PGRs) are small, simple molecules of diverse chemical composition. The PGRs can be broadly divided into two groups based on their functions in a living plant body. One group of PGRs are involved in growth promoting activities, such as cell division, cell enlargement, pattern formation, tropic growth, flowering, fruiting and seed formation. These are also called plant growth promoters, e.g., auxins, gibberellins and cytokinins.
- The PGRs of the other group play an important role in plant responses to wounds and stresses of biotic and abiotic origin. They are also involved in various growth inhibiting activities such as dormancy and abscission. The PGR abscisic acid belongs to this group. The gaseous PGR, ethylene, could fit either of the groups, but it is largely an inhibitor of growth activities.
- Abscisic acid (ABA) was discovered for its role in regulating abscission and dormancy. But like other PGRs, it also has other wide ranging effects on plant growth and development. **It acts as a general plant growth inhibitor and an inhibitor of plant metabolism.** ABA inhibits seed germination. ABA stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kinds of stresses.

Therefore, it is also called the stress hormone. ABA plays an important role in seed development, maturation and dormancy. By inducing dormancy, ABA helps seeds to withstand desiccation and other factors unfavourable for growth. In most situations, ABA acts as an antagonist to GAs.

- **Hence option (a) is the correct answer.**

Q 30.B

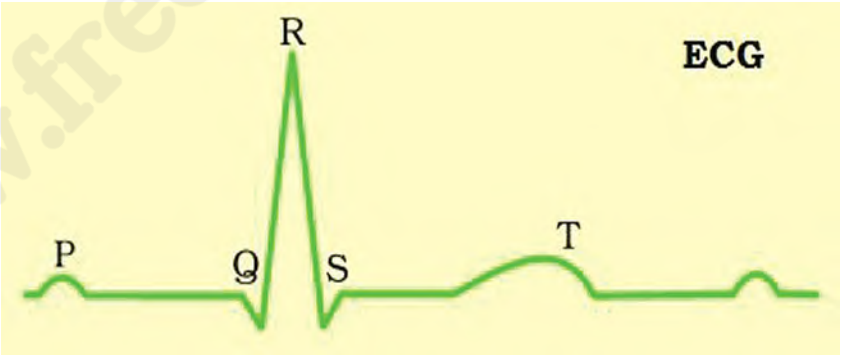
- **The boiling point of water decreases with a decrease in pressure and increases with an increase in pressure.** Food is cooked in less time in a pressure cooker because the pressure increases inside the cooker which also increases the boiling point of water (the boiling point of water now becomes 120 degrees C as opposed to 100 degrees C attained in open vessels).
- **More heat is required to reach the boiling point which is sufficient to cook food in a reduced time.**
- **Hence, option (b) is the correct answer.**

Q 31.D

- **Light can be described both as a wave and as a particle.** Wave-particle duality is a theory that describes that light has both wave and particle nature. The key difference between the wave and particle nature of light is that the wave nature of light explains that light can behave as an electromagnetic wave, whereas the particle nature of light explains that light consists of particles called photons.
- The wave nature of light shows up in the phenomena of interference, diffraction, and polarisation. On the other hand, in the photoelectric effect and Compton effect which involve energy and momentum transfer, radiation behaves as if it is made up of a bunch of particles – the photon.
- **Photo-electric effect:**
  - The emission of free electrons from a metal surface when light is shone on it, is called photoemission or the photoelectric effect. This effect led to the conclusion that light is made up of packets or quantum of energy. This strongly supported the particle nature of light and these particles were named photons. Thus, the wave-particle duality of light came into the picture.
  - **Hence option (d) is the correct answer.**

Q 32.D

- **Electro-cardiograph is used to obtain an electrocardiogram (ECG). ECG is a graphical representation of the electrical activity of the heart during a cardiac cycle.**
- To obtain a standard ECG, a patient is connected to the machine with three electrical leads (one to each wrist and to the left ankle) that continuously monitor the heart activity.
- For a detailed evaluation of the heart's function, multiple leads are attached to the chest region.
- **Each peak in the ECG is identified with a letter from P to T that corresponds to a specific electrical activity of the heart.**
- **The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. Hence, statement 1 is not correct.**
- **The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole. Hence, statement 2 is correct.**
- **The T-wave represents the return of the ventricles from excited to normal state (repolarization). The end of the T-wave marks the end of systole. Hence, statement 3 is not correct.**



- **By counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate of an individual.**
- Since the ECGs obtained from different individuals have roughly the same shape for a given lead configuration, any deviation from this shape indicates a possible abnormality or disease. Hence, it is of a great clinical significance.

www.freeprelimsmaterial.org

Q 33.B

- **National Financial Reporting Authority (NFRA) has published draft requirements for auditors to prepare and publish annual transparency reports to increase transparency in management and governance of audit firms.**
- NFRA was constituted in 2018 under section 132(1) of **Companies Act, 2013.** It consists of a chairperson who will be appointed by Central Government and a maximum of 15 members. **Hence, statement 1 is not correct.**
- **The duties of the NFRA are to:**
  - **Recommend accounting and auditing policies and standards to be adopted by companies for approval by the Central Government;**
  - Monitor and enforce compliance with accounting standards and auditing standards;
  - Oversee the quality of service of the professions associated with ensuring compliance with such standards and suggest measures for
  - **Improvement in the quality of service;**
  - Perform such other functions and duties as may be necessary or incidental to the aforesaid functions and duties.
- **It is an independent regulator to oversee auditing profession and accounting standards** with jurisdiction extending to all listed companies and large unlisted companies. **Hence, statement 2 is correct.**
- **It has same powers as a civil court while trying a suit. Hence, statement 3 is not correct.**
- Sub Rule (1) of Rule 4 of the NFRA Rules, 2018 , provides that the Authority shall protect the public interest and the interests of investors, creditors and others associated with the companies or bodies corporate governed under Rule 3 by establishing high quality standards of accounting and auditing and exercising effective oversight of accounting functions performed by the companies and bodies corporate and auditing functions performed by auditors.

Q 34.C

- **There is air trapped in between the wool fibers in case of combined blankets**. Hence air together with wool conducts less heat through the blanket as this air prevents the flow of heat from our body to the cold surroundings. Such is not the case with a single blanket.
- **Hence option (c) is the correct answer.**

Q 35.B

- **A sound wave is a vibration** that is transmitted through a medium, such as air, water, and metals. Ultrasonic wave (or ultrasound) is defined as "inaudible sound with high frequency for humans" the frequency of which generally exceeds 20 kHz. Ultrasound is sound waves with frequencies higher than the upper audible limit of human hearing.
- **The following technologies are based on ultrasound waves:**
  - **Echocardiography (ECHO):** It is **used to examine the heart.** It is a safe and noninvasive technique. Echocardiography can be used to detect whether the heart muscle is moving normally and how much blood the heart is pumping out with each beat. This procedure can also detect abnormalities in the heart's structure, such as defective heart valves, birth defects (such as holes in the walls between the heart's chambers), and enlargement of the heart's walls or chambers, as occurs in people with high blood pressure, heart failure, or impairment of the heart's muscular walls (cardiomyopathy). **Hence option 2 is correct.**
  - **Ultrasound scanner:** An ultrasound scan is **used to examine internal body structures.** Ultrasound imaging sends out (emits) high-frequency sound waves, directed at the tissue being examined, and records the reflected sound or echoes to create an image. An ultrasound scan is generally non-invasive.
  - **Ultrasonography:** It uses high-frequency sound (ultrasound) waves to produce images of internal organs and other tissues. A device called a transducer converts electrical current into sound waves, which are sent into the body's tissues. Sound waves bounce off structures in the body and are reflected back to the transducer, which converts the waves into electrical signals. A computer converts the pattern of electrical signals into an image, which is displayed on a monitor and recorded as a digital computer image. No x-rays are used, so there is no radiation exposure during ultrasonography. So, it is **used for the examination of the fetus during pregnancy. Hence option 1 is correct.**
- **RADAR: The term RADAR was coined in 1940 by the United States Navy as an acronym for radio detection and ranging.** Radar is a radiolocation system that uses **radio waves** (**and not sound waves**) to determine the distance (ranging), angle, and radial velocity of objects relative to the site. It is used to detect and track aircraft, ships, spacecraft, guided missiles, and motor vehicles, and map weather formations, and

terrain. A radar system consists of a transmitter producing electromagnetic waves in the radio or microwave domain, a transmitting antenna, a receiving antenna (often the same antenna is used for transmitting and receiving), and a receiver and processor to determine the properties of the objects. **Hence option 3 is not correct.**

Q 36.A

- A Lagrangian point is a position or location in space where the combined gravitational forces of two large bodies is equal to the centrifugal force that is felt by a third body which is relatively smaller. **A Lagrangian point is also known as a Lagrange point, Liberation point, or L-point. These points are locations in an orbital arrangement of two large bodies where a third smaller body, affected solely by gravity, is capable of maintaining a stable position relative to the two larger bodies. Hence option (a) is the correct answer.**
- In the Sun-Earth system, the first point (L1) lies between the Sun and Earth and the second point (L2) lies in the opposite direction of the Sun, with both L1 and L2 at a distance of about 1 million miles from the Earth. The third point (L3) lies opposite the orbit of the Earth behind the Sun. All of these three points are unstable.
- The fourth and fifth points, i.e. L4 and L5, lie along the orbit of Earth, with one being ahead of it and the other behind it, at an angle of 60 degrees. Points L4 and L5, unlike L1, L2 and L3, are stable points.In the Aditya - L1 mission, the first Indian mission to study the Sun, a satellite will be placed in the halo orbit around the Lagrangian point 1 (L1) of the Sun-Earth system.

Q 37.A

- **Formic acid or Methanoic Acid** is present in a natural state in stinging nettles and is responsible for the burning pain in contact with them. It is also found in the stings and bites of many insects, including bees and ants, which use it as a chemical defence mechanism. When the ant contracts its poison gland, the formic acid stored in this gland passes in the sting and is propelled out in jets (up to a distance of one meter in some species!) toward the attackers of the ant. Since formic acid has a pH of ~2-3, the attackers usually flee or are killed. **Hence, option (a) is the correct answer.**

Natural source	Acid	Natural source	Acid
Vinegar	Acetic acid	Sour milk (Curd)	Lactic acid
Orange	Citric acid	Lemon	Citric acid
Tamarind	Tartaric acid	Ant sting	Methanoic acid
Tomato	Oxalic acid	Nettle sting	Methanoic acid

Q 38.A

- **Bioplastic** refers to **plastic made from plants** like maize, wheat or sugarcane or other biological material instead of petroleum. **Bio-plastics are biodegradable and compostable plastic materials.**
- **Polyhydroxyalkanoates (PHAs)** are polyesters produced in nature by numerous microorganisms, including through **bacterial fermentation of sugars or lipids.** These plastics are biodegradable and are used in the production of bioplastics. **Hence option 1 is correct.**
- **Polylactic acid (PLA)** is a thermoplastic polyester formally obtained by **condensation of lactic acid with loss of water.** PLA has become a popular material due to it being economically produced from renewable resources and in 2021, had the highest consumption volume of any bioplastic of the world. **Hence option 2 is correct.**
- **Polyethylene terephthalate (PET or PETE)** is a strong, stiff **synthetic fibre** and resin and a member of the polyester family of polymers. **Hence option 3 is not correct.**

www.upscpublished.org

Q 39.B

Table 12.1: Speed of sound in different media at 25 ţC

State	Substance	Speed in m/s
Solids	Aluminium	6420
	Nickel	6040
	Steel	5960
	Iron	5950
	Brass	4700
	Glass (Flint)	3980
Liquids	Water (Sea)	1531
	Water (distilled)	1498
	Ethanol	1207
	Methanol	1103
Gases	Hydrogen	1284
	Helium	965
	Air	346
	Oxygen	316
	Sulphur dioxide	213

- **Hence statement 1 is correct**.
- The speed of sound in a medium depends on the temperature of the medium. The speed of sound decreases when we go from a solid to a gaseous state. In any medium, as we increase the temperature the speed of sound increases. For example, the speed of sound in air is 331 m s–1 at 0 ºC and 344 m s–1 at 22 ºC. **Hence statement 2 is correct**.
- In the case of gases, sound travels faster in gases with low density. Since the speed of sound in air is 346 m/s and in oxygen 316 m/s at 25 ºC. **Hence statement 3 is not correct**.

Q 40.B

- **Human eat various types of food which has to pass through the digestive tract.** Naturally the food has to be processed to generate particles which are small and of the same texture. This is achieved by crushing the food with our teeth.
- When we eat something we like, our mouth 'waters'. This is actually not only water, but a **fluid called saliva secreted by the salivary glands.**
- The food we ingest is its complex nature. If it is to be absorbed from the alimentary canal, it has to be broken into smaller molecules.
- This is done with the help of biological catalysts called enzymes. **The saliva contains an enzyme called salivary amylase that breaks down starch which is a complex molecule to give simple sugar.** The food is mixed thoroughly with saliva and moved around the mouth while chewing by the muscular tongue.
- From the mouth, the food is taken to the stomach through the food-pipe or oesophagus. The stomach is a large organ which expands when food enters it. The muscular walls of the stomach help in mixing the food thoroughly with more digestive juices.
- The digestion in stomach is taken care of by the gastric glands present in the wall of the stomach. These release hydrochloric acid, a protein digesting enzyme called pepsin, and mucus.
- **Gastric chief cells (in the stomach) secrete pepsin as an inactive zymogen called pepsinogen. Pepsin in gastric juice digests proteins such as those in meat, eggs, seeds, or dairy products. The hydrochloric acid creates an acidic medium which facilitates the action of the enzyme pepsin. Hence option 1 is not correct.**
- **The food coming from the stomach is acidic and has to be made alkaline for the pancreatic enzymes to act.** The pancreas contains exocrine glands that produce enzymes important to digestion. **These enzymes**

include trypsin and chymotrypsin to digest proteins; amylase for the digestion of carbohydrates; and lipase to break down fats. Hence option 2 is correct.

- **Lactase is an enzyme found in the mammalian small intestine that digests lactose, which is a sugar found in milk.** Mammals use milk to feed their young, and in most mammals, the activity of lactase decreases after the young is weaned and can consume other foods. **Hence option 3 is correct.**

Q 41.B

- The **combining capacity of the atoms of elements**, that is, their tendency to react and form molecules with atoms of the same or different elements, is explained as **an attempt to attain a fully-filled outermost shell.**
- In general, noble gases like **Helium, Argon, Krypton, Neon, Xenon, Radon, etc.** are not very reactive, their chemical inertness is due to the fact that they have **completely filled ns2np6 electronic configuration of their valence shells.** The other reasons are very high ionization enthalpy and almost zero electron affinity.
- **Hence, option (b) is the correct answer.**

Q 42.C

- **Sorbitol, also called D-sorbitol is a type of carbohydrate.** It falls into a category of **sugar alcohols called polyols.** It is a water-soluble compound and is found naturally in some fruits, including apples, apricots, dates, berries, peaches, plums, and figs.
- It is also commercially manufactured from corn syrup for use in packaged foods, beverages, and medications.
- **Applications of Sorbitol:**
  - Sorbitol is a **starch sweetener** often used as a **substitute for traditional sugar in diet foods** (including diet drinks) and confectionary items (cakes, biscuits, etc.) **Hence option 1 is correct.**
  - Sorbitol along with glycerol helps to **hold the toothpaste together, and it's also a sweetening agent. Hence option 4 is correct.**
  - Anti-diarrheal medication is used to treat sudden diarrhea (including traveler's diarrhea). It works by slowing down the movement of the gut and works in a manner opposite to the laxatives. It is used on its own as a **laxative to combat constipation.** It's hyperosmotic, meaning it draws water into the colon from surrounding tissues to promote bowel movements. **Hence option 2 is not correct.**
  - Used as a humectant and thickener in making **cosmetic creams and milky lotions**
  - It is used in the **preparation of synthetic vitamin C.** It is also used as a stabilizer in pharmaceutical products. **Hence option 3 is correct.**

Q 43.A

- **Acid rain** is made up of highly acidic water droplets due to air emissions, most specifically the **disproportionate levels of sulfur dioxide and oxides of nitrogen. emitted by vehicles and manufacturing processes. Hence, statement 1 is correct.**
- Sulfur and Nitrogen particles which get mixed with water are found in two ways either **man-made** i.e as the emissions that are given out from industries or by **natural causes** like lightning strikes in the atmosphere releasing nitrogen oxides and volcanic eruptions releasing sulfur oxide.
- The pH scale measures how acidic an object is. The scale has values ranging from zero (the most acidic) to 14 (the most basic). Pure water has a pH value of 7, this value is considered neutral—neither acidic nor basic. However, when rain combines with sulfur dioxide or nitrogen oxides—\—the rain becomes much more acidic. **Typical acid rain has a pH value of 4. Hence, statement 2 is not correct.**

Q 44.D

- Nuclear applications in agriculture rely on the use of isotopes and radiation techniques to combat pests and diseases, increase crop production, protect land and water resources, ensure food safety and authenticity, and increase livestock production. The nuclear-derived sterile insect technique (SIT) involves mass-rearing and sterilizing male insects before releasing them over pest-infested areas. **Hence option 1 is correct.**
- Common uses of nuclear medicine for diagnosis include, scans of the heart, lungs, kidneys, gallbladder, and thyroid **Hence option 2 is correct.**
- Radioactive sources are used for logging formation parameters. Radioactive tracers, along with the other substances in hydraulic-fracturing fluid, are sometimes used to determine the injection profile and location of fractures created by hydraulic fracturing. there is wide use of isotopes for measuring the steam quality before infusion into almost obsolete wells of oil to force out residual supplies**. Hence option 3 is correct.**

- Nuclear medicine therapy uses a small amount of radioactive material combined with a carrier molecule. This is called a radiopharmaceutical. Nuclear medicine therapies treat cancer and other conditions. Radiopharmaceuticals attach to specific cells and then deliver a high dose of radiation, destroying them. **Hence option 4 is correct.**
- Radioactive isotopes can greatly be utilized for the accurate measurement of pollutants in the environment including groundwater and river. Radioactive isotopic and nuclear tools use to monitor their pathways through the atmosphere, predict their distribution and estimate their impact on ecosystems**. Hence option 5 is correct.**

Q 45.A

- **Stevia** is often used as a **substitute to traditional table sugar.**
- It is derived from a highly **refined stevia leaf extract called rebaudioside A (Reb-A). Hence, statement 1 is correct.**
- Sweeteners made with Reb-A are considered **"novel sweeteners"** because they're blended with different sweeteners, such as erythritol (sugar alcohol) and dextrose (glucose).
- It's about **100 to 300 times sweeter than table sugar**, but it has no carbohydrates, calories, or artificial ingredients in pure form. **Hence, statement 2 is not correct.**

Q 46.C

- **Sodium-based battery** technology might soon be a **viable alternative to lithium-based ones**, according to a study by **the University of Houston.**
- Sodium-ion batteries are rechargeable batteries which require sodium ion movement between electrodes during the charging and discharging of the battery, the cathode for these batteries is manufactured from sodium. Whereas, Lithium-ion batteries use an intercalated lithium compound as electrode material.
- Sodium batteries earlier **require three times the volume of lithium** needed to **produce the same amount of energy.** The biggest downside is that sodium-ion batteries have a lower energy density than lithium-ion batteries. **Hence, statement 1 is correct.**
- Sodium-ion batteries offer better performance and can **operate in a wider temperature range especially colder environments** as compared to Lithium-ion batteries. **Hence, statement 2 is not correct.**
- Sodium-ion batteries are cheaper to produce than their lithium counterparts because of the **abundance of sodium as raw materials** (mined from **soda ash and seawater**, which is easily available across the world). **Hence, statement 3 is correct.**

Q 47.B

- Sound is produced by vibrating objects.
- The matter or substance through which sound is transmitted is called a medium.
- Sound is a mechanical wave and needs a material medium like air, water, steel, etc., for its propagation. It cannot travel through a vacuum.
- Electromagnetic waves differ from mechanical waves in that they do not require a medium to propagate. This means that electromagnetic waves can travel not only through the air and solid materials but also through the vacuum. **Hence statement 1 is not correct.**
- In longitudinal waves, particles do not move from one place to another but they simply oscillate back and forth about their position of rest. This is exactly how a sound wave propagates, hence sound waves are longitudinal waves. **Hence statement 2 is correct.**
- In a transverse wave, particles do not oscillate along the line of wave propagation but oscillate up and down about their mean position as the wave travels. Thus a transverse wave is one in which the individual particles of the medium move about their mean positions in a direction perpendicular to the direction of wave propagation.

Q 48.D

- A pesticide is any substance used to kill, repel, or control certain forms of plant or animal life that are considered to be pests.
- **Bacteria-based pesticides** use subspecies and strains of **Bacillus thuringiensis, or Bt** making it the most widely used microbial pesticide.
- **Fungal-based pesticides (mycoinsecticide) like Beauveria bassiana and Metarhizium anisopliae** can be used to control plant diseases as well as some pests and weeds.
- **Microbial viral insecticides** are pathogens that attack insects and other arthropods. Viruses like **Baculoviruses** are used as insecticides/pesticides.

- **Protozoa-based pesticides use the Microsporidia group** to control the population of insects including caterpillar pests, grasshoppers, corn earworms, armyworms, European corn borers, cabbage loopers, and fall webworms.
- **Hence, option(d) is the correct answer.**

Q 49.D

- **Ministry of Environment, Forests and Climate Change (MoEFCC) notifies norms for fly ash utilization by power plants.**
  - MoEFCC has notified the **latest amendments exercising the power under the Environment (Protection) Act 1986.** Amendments are aimed at better utilization of fly ash by coal-based thermal power plants (TPPs) in the country.
- **About Fly ash:**
  - **Ash is the mineral matter left after burning coal. In a power plant, a major portion of the ash is carried off with flue gases (hence, the term fly ash), and can be filtered using electrostatic precipitators.** Due to improper handling, it ends up in neglected ash ponds in dangerous quantities, polluting the surface and groundwater.
- **Composition: substantial amounts of oxides of silicon, aluminum, calcium; arsenic, boron, chromium, lead, etc. in trace concentrations.**
- Usage: manufacturing of Portland cement, bricks, tiles, manufacturing of absorbents (for purification of waste gases, drinking water), etc.

Chemical Composition	*Fly Ash* (%)	Lime (%)
C	23.29	0
CaO	3.10	91.99
SiO_2	36.10	3.75
Al_2O_3	25.03	2.09
FeO	8.66	0.50
MgO	1.24	1.19
Na_2O	0	0.43
SO_3	0.59	0.05
TiO_2	0.91	0
K_2O	1.08	0
TOTAL	100.00	100.00

- **Hence, option (d) is the correct answer.**

Q 50.B

- Dark energy is an unknown form of energy that affects the universe on the largest scales. The first observational evidence for its existence came from measurements of supernovas which showed that the universe does not expand at a constant rate; rather, the universe's expansion is accelerating. Dark energy was discovered in **1998** with this method by two international teams that included American astronomers Adam Riess (the author of this article) and Saul Perlmutter and Australian astronomer Brian Schmidt. **Hence statement 1 is not correct.**
- The rate of expansion of the universe and its acceleration can be measured by observations based on the Hubble law. These measurements, together with other scientific data, have confirmed the existence of dark energy and provide an estimate of just how much of this mysterious substance exists.
- **Roughly 68% of the universe is dark energy.** Dark matter is called "dark" because it does not interact with electromagnetic force. This means it does not absorb, reflect or emit light, making it extremely hard to spot. In fact, researchers have been able to infer the existence of dark matter only from the gravitational effect it seems to have on visible matter. Dark matter seems to outweigh visible matter roughly six to one, making up about 27% of the universe. **Hence statement 2 is correct.**
- Dark energy and dark matter constitute 95% of the total mass-energy content.

Q 51.C

- **Blood coagulation or clotting is an important phenomenon to prevent excess loss of blood in case of injury or trauma.** The blood stops flowing from a wound in case of injury. **The blood clot or 'coagulum' is formed by a network of fibrin threads.**

www.visionias.org

- In this network, deformed and dead formed elements (erythrocytes, leukocytes and platelets) get trapped.
- **Prothrombin is the inactive form of thrombin that is present in the plasma. Thrombokinase converts prothrombin to active thrombin which in turn activates fibrinogen to fibrin. All these clotting factors help in blood coagulation.**
- An injury stimulates platelets or thrombocytes to release various factors that initiate the blood clotting cascade. Calcium ions play an important role in blood coagulation.
- **The process of blood coagulation leads to haemostasis, i.e. prevention of bleeding or haemorrhage. Hence statement 1 is correct.**
  - **Primary haemostasis** involves platelet aggregation and formation of a plug at the site of injury, and
  - **Secondary haemostasis** involves strengthening and stabilisation of platelet plug by the formation of a network of fibrin threads.
- **Haemophilia is the main blood clotting disorder.**
  - **Haemophilia is characterised by excessive bleeding.**
  - **It is due to the absence of some of the factors required in the blood clotting cascade. Hence, statement 2 is correct.**
  - **It is usually an inherited bleeding disorder in which the blood does not clot properly.**
  - **This can lead to spontaneous bleeding as well as bleeding following injuries or surgery.** Blood contains many proteins called clotting factors that can help to stop bleeding.
  - People with hemophilia have low levels of **either factor VIII (8) or factor IX (9).** The severity of hemophilia that a person has is determined by the amount of factor in the blood.
  - **The lower the amount of the factor, the more likely it is that bleeding will occur** which can lead to serious health problems.
- **Thrombosis is the formation of a blood clot inside the blood vessel. It blocks the flow of blood.** Thrombosis can occur in arteries as well as veins. Arterial thrombosis affects the blood supply and leads to the damage of tissue, i.e. ischemia or necrosis. The clot may sometimes break free and circulate in the body and lead to embolism.

Q 52.C

- **Domestic Electric Circuit:**
  - In our homes, we receive a supply of electric power through a main supply (also called mains), either supported by overhead electric poles or by underground cables.
  - One of the wires in this supply, usually with red insulation cover, is called live wire (or positive). Another wire, with black insulation, is called neutral wire (or negative).
  - In our country, the **potential difference between the two is 220 V**. At the meter board in the house, these wires pass into an electricity meter through a main fuse. Through the main switch, they are connected to the line wires in the house. **Hence statement 2 is correct.**
  - These wires supply electricity to separate circuits within the house. Often, two separate circuits are used, one of 15 A current ratings for appliances with higher power ratings such as geysers, air coolers, etc. The other circuit is of 5 A current rating for bulbs, fans, etc. The earth wire, which has insulation of green color, is usually connected to a metal plate deep in the earth near the house. This is used as a safety measure, especially for those appliances that have a metallic body, for example, electric press, toaster, table fan, refrigerator, etc.
  - The **metallic body is connected to the earth wire,** which provides a low-resistance conducting path for the current. Thus, it ensures that any leakage of current to the metallic body of the appliance keeps its potential to that of the earth, and the user may not get a severe electric shock. **Hence statement 1 is correct.**
  - **Home appliances are connected in parallel to each other.** The reasons why different electrical appliances in a domestic circuit are connected in parallel are: All the appliances get their rated voltage so that they function efficiently. All the components can have their independent switch to control them. If one appliance gets faulty, it doesn't affect the other appliances. **Hence statement 3 is not correct.**

Q 53.D

- **Overloading in the circuits:** If suddenly the voltage in a circuit increases, it carries more current than usual. This situation is called overloading.
  - The electric fuse is an important component of all domestic circuits. A fuse in a circuit prevents damage to the appliances and the circuit due to overloading.
  - Overloading can occur **when the live wire and the neutral wire** come into direct contact. (This occurs when the insulation of wires is damaged or there is a fault in the appliance.) In such a situation, the current in the circuit abruptly increases. This is called short-circuiting. The use of an electric fuse

prevents the electric circuit and the appliance from possible damage by stopping the flow of unduly high electric current. The Joule heating that takes place in the fuse melts it to break the electric circuit. **Hence option 1 is correct.**
    - Overloading can also occur **due to an accidental hike in the supply voltage. Hence option 2 is correct.**
    - Sometimes overloading is caused **by connecting too many appliances to a single socket. Hence option 3 is correct.**

Q 54.A

- Fiberisation is the process of connecting radio towers with each other via optical fiber cables. It represents the part of the network that connects the core of the network to the edge facilitating large amounts of data used in 5G services. **Hence option (a) is the correct answer.**
- Also, it provides additional bandwidth and stronger backhaul support. In India, currently, only 33% of the towers are fiberized, compared to 80%-90% in the U.S., Japan, and China. To transition to 5G, India needs at least 16 times more fiber.
- **Challenges to Fiberisation**
    - Monetary constraints like India require ₹2.2 lakh crore of investment to help fiberize 70% of towers.
    - Time constraints like to connect every village in the country with optical fiber cable (OFC) in 1000 days, cables must be laid at a speed of 1251 km a day, around 3.6 times the current speed.
    - Ineffective implementation of Indian Telegraph Right of Way (RoW) Rules 2016 which provide for one-time compensation and uniform procedure for the establishment of Overground Telegraph Line (OTL).
- Against the backdrop of the 5G spectrum auction for telecom airwaves by the Indian government, the challenge for requisite infrastructure in terms of fiberisation challenge is underscored.

Q 55.C

- **Recently, the biggest Rare Earth Elements (REE) deposit in Europe has been discovered in Sweden. REE deposits were discovered in Arctic region of Kiruna, Sweden (home to world's largest underground iron-ore mine).**
- Rare earth elements are a **group of seventeen chemical elements that occur together in the periodic table.** The group consists of yttrium, scandium and the 15 lanthanide elements (lanthanum, cerium, praseodymium, **neodymium, promethium,** samarium, europium, gadolinium, terbium, dysprosium, **holmium,** erbium, thulium, ytterbium, and lutetium). **Hence options 1, 2 and 3 are correct.**
- **The rare earth elements are all metals, and the group is often referred to as the "rare earth metals."** These metals have many similar properties, and that often causes them to be found together in geologic deposits.
- **Rare earth elements are not as "rare" as their name implies. Thulium and lutetium are the two least abundant rare earth elements - but they each have an average crustal abundance that is nearly 200 times greater than the crustal abundance of gold. However, these metals are very difficult to mine because it is unusual to find them in concentrations high enough for economical extraction.**
- **China began producing notable amounts of rare earth oxides in the early 1980s and became the world's leading producer in the early 1990s.** Through the 1990s and early 2000s, China steadily strengthened its hold on the world's rare earth oxide market. They were selling rare earths at such low prices that the Mountain Pass Mine and many others throughout the world were unable to compete and stopped operation.

Q 56.D

- **Microbes cause a large number of diseases in human beings.** They also cause diseases in animals and plants.
- But all microbes are harmful; several microbes are useful to man in diverse ways.
- **Micro-organisms such as Lactobacillus and others commonly called lactic acid bacteria (LAB) grow in milk and convert it to curd.**
    - During growth, the LAB produce acids that coagulate and partially digest the milk proteins.
    - A small amount of curd added to the fresh milk as inoculum or starter contain millions of LAB, which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing vitamin B12. **Hence option 1 is correct.**
- **Aspergillus niger is a fungal microbe of great industrial importance.**
    - This mold is used extensively in the production of citric acid and in the production of several enzymes such as amylases, pectinases, and proteases.

- **Food scientists and producers use Aspergillus niger to make ingredients like gluconic acid and citric acid.**
- **Gluconic acid regulates the acidity of food products like wine and is a natural preservative. Hence option 2 is correct.**

- **Streptococcus thermophilus (S. thermophilus) is a type of probiotic ("good" bacteria) found in the digestive tract.**
  - It produces lactic acid in the gut.
  - "Good" bacteria such as S. thermophilus can help break down food, absorb nutrients, and fight off "bad" organisms that might cause diseases.
  - **S. thermophilus is commonly used to produce fermented dairy foods such as yogurt.**
  - **It is also used in probiotic supplements.**
  - People use S. thermophilus for diarrhea, constipation, colic, and many other conditions, but there is no good scientific evidence to support these uses. There is also no good evidence to support using S. thermophilus for COVID-19.
  - **Its special structure also means that it can survive in higher temperatures; hence its name.**
  - **This not only makes it handy for industrial operations in fermented dairy products, but also means that it's a very resistant and functional probiotic. Hence option 3 is correct.**

Q 57.A

- Recent context: Researchers reported fourth patient of HIV cured after stem cell transplant (SCT).
- SCT, also called bone marrow transplant, is a procedure in which a patient receives healthy stem cells to replace damaged stem cells. **Hence statement 1 is correct.**
- **Two main types:**
  - **Autologous transplantation:** Uses patient's own stem cells. These cells are removed, treated and returned to his body after a conditioning regimen.
  - Allogeneic transplantation: Uses stem cells from a donor. **Hence statement 2 is not correct.**
- Stem cells are special human cells that are able to develop into many different cell types such as muscle/blood/brain cells.

Q 58.B

- Connective tissue (also called fibrous tissue) is one of the four primary types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. Connective tissues, as the name implies, support and connect different tissues and organs of the body. They are widely distributed in every part of the body.
- **A ligament is a fibrous connective tissue that attaches bone to bone, and usually serves to hold structures together and keep them stable. Two This tissue is very elastic. It has considerable strength.**
- A tendon is a fibrous connective tissue that attaches muscle to bone. Tendons may also attach muscles to structures such as the eyeball. A tendon serves to move the bone or structure.
- Areolar connective tissue is found between the skin and muscles, around blood vessels and nerves and in the bone marrow. It fills the space inside the organs, supports internal organs and helps in repair of tissues.
- Cartilage is a strong, flexible connective tissue that protects your joints and bones. It acts as a shock absorber throughout your body. Cartilage at the end of your bones reduces friction and prevents them from rubbing together when you use your joints.
- **Hence option (b) is the correct answer.**

Q 59.D

- Nuclear fission is a reaction in which the nucleus of an atom splits into two or smaller nuclei. The fission process often produces gamma photons and releases a very large amount of energy even by the energetic standards of radioactive decay.
- Nuclear fission produces more radioactive waste than nuclear fusion because very few radioactive particles are produced in the case of nuclear fusion. Nuclear fission power plants have the disadvantage of generating unstable nuclei; some of these are radioactive for millions of years. Fusion on the other hand does not create any long-lived radioactive nuclear waste. A fusion reactor produces helium, which is an inert gas. It also produces and consumes tritium within the plant in a closed circuit. Tritium is radioactive (a beta emitter) but its half-life is short. It is only used in low amounts. **Hence statement 1 is correct.**
- Nuclear Fission reaction does not occur normally in nature.
- The isotopes uranium-235 and plutonium-239 were selected by atomic scientists because they readily undergo fission. Fission occurs when a neutron strikes the nucleus of either isotope, splitting the nucleus into fragments and releasing a tremendous amount of energy. The fission process becomes self-sustaining

www.freeprelimsmaterials.org

as neutrons produced by the splitting of atom strike nearby nuclei and produce more fission. This is known as a chain reaction and is what causes an atomic explosion. **Hence statement 2 is correct.**

- To make a hydrogen bomb, one would still need uranium or plutonium as well as two other isotopes of hydrogen, called deuterium and tritium. The hydrogen bomb relies on fusion, the process of taking two separate atoms and putting them together to form a third atom. Hydrogen bombs are also harder to produce but lighter in weight, meaning they could travel farther on top of a missile. Although hydrogen bombs do use fusion reactions, they require an additional fission bomb to detonate.
- The energy released by fission is a million times greater than that released in chemical reactions; but lower than the energy released by nuclear fusion. **Hence statement 3 is correct.**
- Nuclear Fusion occurs when two atoms slam together to form a heavier atom, like when two hydrogen atoms fuse to form one helium atom. Fusion occurs in stars, such as the sun.
  - The energy released by fusion is three to four times greater than the energy released by fission.

Q 60.B

- Plant growth and development are largely determined by nutrient availability. Plants require two types of nutrients- macronutrients and micronutrients.
- **Macronutrients** are the nutrients required by plants in large amounts. These include **carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, calcium, and potassium**. **Micronutrients** are the ones required in very small amounts by plants. These include **iron, zinc, boron, iron, manganese, molybdenum, etc. Hence, statement 1 is not correct.**
- **Zinc** is also involved in the activation of certain enzymes and is essential for **growth hormone production and internode elongation** in plants. **Hence, statement 2 is correct.**

Q 61.C

- **Standalone 5G and Non-Standalone 5G**
  - 5G networks are deployed mainly in two modes: standalone and non-standalone.
  - Both architectures have advantages and disadvantages, and the path chosen by operators primarily reflects their view of the market for the new technology.
  - In the standalone mode the 5G network operates with dedicated equipment, and runs parallel to the existing 4G network, while in a non-standalone way, the 5G network is supported by the 4G core infrastructure.
  - Given that the non-standalone networks are built on existing infrastructure, the initial cost and the time taken to roll out services through this track are significantly less than standalone networks.
- **Non-Standalone 5G**
  - The initial rollouts of 5G networks provide customers with higher data transfer speeds by pairing a 5G Radio Access Network (RAN) with the LTE Evolved Packet Core (EPC). Because the 5G RAN remains reliant on the 4G core network to manage control and signaling information and the 4G RAN continues to operate, this is called a Non-Standalone Architecture.
  - By **leveraging the existing infrastructure of a 4G network,** carriers are able to provide faster and more reliable Enhanced Mobile Broadband (eMBB) without completely reworking their core network technology and pushing customers to new devices. Non-Standalone 5G provides a transitionary platform for carriers and customers alike.
- **Standalone 5G**
  - Standalone 5G does **not depend on an LTE EPC to operate.** Instead, it pairs 5G radios with a cloud-native 5G core network. The 5G core itself is designed as a Service Based Architecture (SBA) that virtualizes network functions altogether, providing the full range of 5G features enterprise needs for factory automation, autonomous vehicle operation, and more.
- **Comparing Standalone 5G and Non-Standalone 5G**
  - NSA 5G helps network operators maximize their existing LTE infrastructure while providing enterprises and users with faster and more reliable communications than ever before, thanks to 5G's eMBB. But eMBB only scratches the surface of 5G's promise. **Non-standalone networks are built on existing infrastructure. Hence, statement 2 is correct.**
  - The SA 5G core architecture enables a host of new features and functionality beyond more bandwidth. These include Ultra-Reliable Low Latency Communications (URLCC), a key feature for applications requiring near-real-time responsiveness–things like autonomous driving vehicles, precision robotics, and machine vision. Massive IoT, with specialized machine-to-machine communication protocols, is also a key feature associated with Standalone 5G. **In the standalone mode, the 5G network operates with dedicated equipment and runs parallel to the existing 4G network. Hence, statement 1 is correct.**

www.freeupscmaterials.org

Q 62.D

- Graphene is most simply defined as **a single layer of carbon atoms** bonded together in a **hexagonal, sheetlike structure.**
- Advances in graphene technology have the potential to bring artificial devices to their senses — in bionic eyes and ears.
- Graphene is **impervious to the harsh ionic solutions** found in the human body making it prone to damage. Moreover, graphene's **ability to conduct electrical signals** means it can interface with neurons and other cells that communicate by a nerve impulse, or action potential.
- Apart from its stability and favorable electronic properties, **graphene is also flexible**, so it can be **wrapped around delicate tissues.**
- **Hence option (d) is the correct answer.**

Q 63.B

- When fats and oils are oxidised, they become rancid and their smell and taste change. Usually substances which prevent oxidation (antioxidants) are added to foods containing fats and oil. Keeping food in air tight containers helps to slow down oxidation. The chips manufacturers usually flush bags of chips with gas such as nitrogen to prevent the chips from getting oxidised.
- **Hence option (b) is the correct answer.**

Q 64.B

- **Diamond and Graphite**, both are **allotropes of carbon**. These minerals chemically consist of carbon atoms with different physical properties. **Hence, statement 1 is correct.**
- **Graphite is soft with a greasy touch** and is utilized as a lubricant in the form of dispersion material or powder. **Diamond is the hardest naturally occurring substance** and is used in making tools that are utilized for grinding, cutting, drilling, etc. **Hence, statement 2 is correct.**
- **Graphite** is used in the manufacture of electrodes of carbon employed in electrolytic cells, as it is an **excellent conductor of electricity. In a Diamond,** each carbon atom is attached to the other four carbon atoms through **strong covalent bonds.** Due to the **absence of free electrons, a diamond is a poor electrical conductor. Hence, statement 3 is not correct.**

Q 65.A

- Neutrinos are fundamental particles created in a wide variety of nuclear processes. Protons, neutrons, and electrons are tiny particles that makeup atoms. The neutrino is also a tiny elementary particle, but it is not part of the atom. Such particles are also found to exist in nature. Neutrino has a very tiny mass, no charge, and spin half. It interacts very weakly with other matter particles. So weakly that every second trillion of neutrinos fall on us and pass through our bodies unnoticed. **Hence statement 1 is correct.**
- Neutrinos change the way they spin depending on how far they have traveled and how much matter they have passed through. If the properties are studied thoroughly and suitable detectors built, they can reveal the presence of minerals and oil deposits. **Hence statement 2 is correct.**
- Neutrino oscillation was established by Sudbury Neutrino Observatory, Canada, and Super-Kamiokande experiment in Japan. They studied Solar neutrinos, atmospheric neutrinos, and man-made neutrinos. It's the process of fission inside the nuclear reactor that eventually leads to the birth of neutrinos through beta decay. **Hence statement 3 is not correct.**
- **Other use of neutrinos:**
  - Scientists have already shown that it's possible to detect neutrinos emitted from the decay in nuclear reactors and have proposed using neutrino detectors to locate undocumented nuclear reactors or reactors that are secretly harvesting plutonium.
  - Use in communication, Scientists have proven that it's possible to encode a message in neutrinos using binary code.
  - the neutrinos are carriers of information regarding the universe.
  - neutrinos can help in identifying the geological defect deep inside the earth, thereby answering the question of an early warning system for an earthquake.

www.freeiasmaterials.org

Q 66.C

- Human blood group inheritance shows an example of codominance as well as multiple alleles. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene. The gene (I) has three alleles I^A, I^B and *i*. The alleles I^A and I^B produce a slightly different form of sugar while allele *i* do not produce any sugar. ***i* is recessive to both I^A, and I^B. $I^A$and I^B may show codominance.**

Table 5.2: Table Showing the Genetic Basis of Blood Groups in Human Population

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	*i*	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	*i*	$I^B i$	B
i	*i*	*i i*	O

- The parents have A and AB, blood groups. Blood group A indicates that the underlying genotype may be $I^A I^A$ or I^A *i*. Blood group AB indicates co-dominance and the underlying genotype must be $I^A I^B$.
- Now two cases, In the first case (considering a person with A blood group has I^A *i* genotype: I^A i (A blood group) X $I^A I^B$ (AB blood group)

Gametes	I^A	*i*
I^A	$I^A I^A$ (A blood group)	$I^A i$ (A blood group)
I^B	$I^A I^B$ (AB blood group)	$I^B i$. (B blood group)

  - So, the possible blood groups of children born in this case are A, B, and AB blood groups.
- Similarly in the second case, considering a person with A blood group has $I^A I^A$ genotype): $I^A I^A$ (A blood group) X $I^A I^B$ (AB blood group)

Gametes	I^A	I^A
I^A	$I^A I^A$ (A blood group)	$I^A I^A$ (A blood group)
I^B	$I^A I^B$ (AB blood group)	$I^A I^B$ (AB blood group)

  - So, the possible blood groups of children born in this case are A and AB blood groups.
- **In none of the above cases, children have O blood group.**

Parent 1	Parent 2	Child's possible ABO blood types
A	A	A, O
A	B	A, B, AB, O
A	AB	A, B, AB
A	O	A, O
B	B	B, O
B	AB	A, B, AB
B	O	B, O
AB	AB	A, B, AB
AB	O	A, B
O	O	O

- **Hence option (c) is the correct answer.**

Q 67.C

- **Recently, the Indian Army issued a proposal for vehicle-based drone jammers. Various ways of drone jamming: Radio Frequency jamming, Satellite link disruption, spoofing, and dazzling.**
- **Cybercrime** can be defined as a crime or an unlawful act where the computer is used either as a tool, a target, or both. In other terms, cyber crimes in India can be defined as unauthorized access to some computer system without the permission of the rightful owner or place of criminal activity and include everything from online cracking to denial of service attacks.
- **Some examples of cybercrime include phishing, spoofing, DoS (Denial of Service) attack, credit card fraud, online transaction fraud, cyber defamation, child pornography, etc.**
- **Spoofing:** Spoofing is a type of attack on a computer device in which the **attacker tries to steal the identity of the legitimate user** and act as another person. This kind of attack is done to breach the security of the system or to steal the information of the users. **Hence, statement 1 is correct.**
- **Phishing** is a type of attack on a computer device where the **attacker tries to find the sensitive information of users in a fraudulent manner** through electronic communication by intending to be from a related trusted organization in an automated manner. **Hence, statement 2 is correct.**
- **Spoofing can be part of phishing. But Phishing can't be part of the spoofing. Spoofing doesn't require fraud. But Phishing is operated in a fraudulent manner.**
- **Ransomware Attack:** Ransomware attacks are a very common type of cybercrime. It is a type of malware that has the capability to prevent users from accessing all of their personal data on the system by encrypting them and then asking for a ransom in order to give access to the encrypted data.
- **Hacking/Misusing Computer Networks:** This term refers to the crime of unauthorized access to private computers or networks and misuse of it either by shutting it down or tampering with the data stored or other illegal approaches.
- **Vishing** is an attempt where fraudsters try to seek personal information like Customer ID, Net Banking password, ATM PIN, OTP, Card expiry date, CVV etc. through a phone call.
- **Smishing** is a type of fraud that uses mobile phone text messages to lure victims into calling back on a fraudulent phone number, visiting fraudulent websites or downloading malicious content via phone or the web.
- **Denial of Services (DoS) attack** is an attack intended for denying access to computer resources without the permission of the owner or any other person who is in charge of a computer, computer system or computer network.
    - A **Distributed Denial of Service (DDoS) attack** is an attempt to make an online service unavailable by overwhelming it with traffic from multiple sources.
- **Cryptojacking** is the unauthorized use of computing resources to mine cryptocurrencies.

Q 68.C

- Protein is found throughout the body—in muscle, bone, skin, hair, and virtually every other body part or tissue. It makes up the enzymes that power many chemical reactions and the hemoglobin that carries oxygen in your blood.
- Within a protein, **multiple amino acids are linearly linked together by peptide bonds**, thereby forming a long chain. Peptide bonds are formed by a biochemical reaction that extracts a water molecule as it joins the amino group of one amino acid to the carboxyl group of a neighboring amino acid. **Hence, statement 1 is correct.**
- Collagen is the most **abundant protein in the human body, found in the bones, muscles, skin, and tendons.** It is an essential component of **connective tissue** and plays a crucial role in holding the body's cells together. It also gives strength and elasticity to the skin. **Hence, statement 2 is correct.**

Q 69.C

- **Recently, the sale of the 25th tranche of electoral bonds started.**
- An electoral bond would be a bearer instrument in the **nature of a promissory note and an interest-free banking instrument.** A citizen of India or a body incorporated in India will be eligible to purchase the bond. **Hence, statement 3 is correct.**
- Electoral Bond (s) would be issued/purchased for any value, in multiples of Rs.1,000, Rs.10,000, Rs.1,00,000, Rs.10,00,000, and Rs.1,00,00,000 from the **Specified Branches of the State Bank of India (SBI). Hence, statement 2 is not correct.**
- The purchaser would be allowed to buy Electoral Bond(s) only on due fulfilment of all the extant KYC norms and by making payment from a bank account. It will not carry the name of the payee. **Electoral Bonds would have a life of only 15 days during which they can be used for making donations only to**

the political parties registered under section 29A of the Representation of the People Act, 1951, and which secured not less than one percent of the votes polled in the last general election to the House of the People or a Legislative Assembly. **Hence, statement 1 is not correct.**

- The Electoral Bonds under the Scheme shall be available for purchase **for a period of 10 days each in the months of January, April, July, and October, as may be specified by the Central Government.** An additional period of 30 days shall be specified by the Central Government in the year of the General election to the House of People.
- The Electoral Bond(s) shall be encashed by an eligible political party only through a designated bank account with the authorized bank.
- **Eligibility: Registered political parties that secured at least one percent of votes polled in the most recent General or Assembly elections.**

Q 70.B

- **Mitochondria are known as the powerhouse of the cell.**
  - The energy required for various chemical activities needed for life is released by mitochondria in the form of ATP (Adenosine Triphosphate) molecules. [If Mitochondria is the Power Plant. ATP is the Electricity].
  - **ATP is known as the energy currency of the cell.** The body uses energy stored in ATP for making new chemical compounds and for mechanical work.
- **Lysosomes are a kind of waste disposal system of the cell.**
  - **Lysosomes help to keep the cell clean by digesting any foreign material as well as worn-out cell organelles.**
  - Foreign materials entering the cell, such as bacteria or food, as well as old organelles end up in the lysosomes, which break them up into small pieces.
  - Lysosomes are able to do this because they contain powerful digestive enzymes capable of breaking down all organic material. During the disturbance in cellular metabolism, for example, when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell.
  - **Therefore, lysosomes are also known as the 'suicide bags' of a cell.**
- **The golgi apparatus consists of a system of membrane-bound vesicles arranged approximately parallel to each other in stacks called cisterns.**
  - These membranes often have connections with the membranes of ER and therefore constitute another portion of a complex cellular membrane system.
  - **The material synthesized near the ER is packaged and dispatched to various targets inside and outside the cell through the golgi apparatus.** Its functions include the storage, modification and packaging of products in vesicles
- **A ribosome is a complex molecular machine found inside the living cells that produce proteins from amino acids during a process called protein synthesis or translation.**
  - The process of protein synthesis is a primary function, which is performed by all living cells.
  - Ribosomes are specialized cell organelles and are found in both prokaryotic and eukaryotic cells.
  - **Every living cell requires ribosomes for the production of proteins.**
- **Hence, option (b) is the correct answer.**

Q 71.A

- **Erythroblastosis fetalis, also called hemolytic disease of the newborn, type of anemia in which the red blood cells (erythrocytes) of a fetus are destroyed in a maternal immune reaction resulting from a blood group incompatibility between the fetus and its mother.**
- This incompatibility arises when the fetus inherits a certain blood factor from the father that is absent in the mother. Symptoms of erythroblastosis fetalis range from mild to severe; death of the fetus or newborn sometimes results.
- **Two blood group systems, Rh and ABO, primarily are associated with erythroblastosis fetalis.**
- The Rh system is responsible for the most severe form of the disease, which can **occur when an Rh-negative woman (a woman whose blood cells lack the Rh factor) conceives an Rh-positive fetus. Hence statement 1 is correct.**
- Sensitization of the mother's immune system (immunization) occurs when fetal red blood cells that carry the Rh factor (an antigen in this context) cross the placental barrier and enter the mother's bloodstream.
- **They stimulate the production of antibodies, some of which pass across the placenta into fetal circulation and lyse, or break apart, the red blood cells of the fetus (hemolysis).**
- **These antibodies usually don't cause problems during a first pregnancy.**

- **But Rh incompatibility may cause problems in later pregnancies, if the baby is Rh-positive.** This is because the antibodies stay in your body once they have formed. The antibodies can cross the placenta and attack the baby's red blood cells. The baby could get Rh disease, a serious condition that can cause a serious type of anemia. **Hence statement 2 is not correct.**
- **It is rare for a mother to become sensitized during the course of her first Rh-positive pregnancy because the amount of fetal Rh antigen that enters maternal circulation is insufficient to cause sensitization; usually only during labour will exposure be significant.**
- However, because Rh sensitivity is likely to develop during labour, the risk of the disease developing in subsequent Rh-positive pregnancies increases.
- **The risk can be reduced if the mother receives injections of Rh immunoglobulin, which destroys fetal red blood cells in her bloodstream, during her first pregnancy. The fetus also is protected from Rh hemolytic disease if an ABO blood group incompatibility exists concurrently; protection is conferred by ABO antibodies, which destroy fetal blood cells in the maternal circulation before the mother develops Rh sensitivity**.
- Fetal-maternal incompatibilities within the ABO blood group alone are more common than those of the Rh type, but the immune reaction is usually much less severe, unless the fetus is type A and the mother type O.

Q 72.C

- **Electric Bulb:**
  - The electric bulb is also known as **an incandescent lamp**, incandescent light globe, or incandescent light bulb.
  - An electric bulb is a small and simple light source that uses a wire filament to glow on the application of electricity.
  - The **filament, which is a coiled thin wire, is made of tungsten.** Tungsten is chosen as filament since it has a high melting point, which avoids the melting of the filament at high temperatures. **Hence statement 1 is correct.**
  - The **filament is enclosed** in a globe-shaped glass mount and is **connected with copper and lead wires** connected to the lamp's base.
  - The **wires and the filament are enclosed in like nitrogen, argon, or krypton - so that the filament doesn't catch fire.** Since argon is an inactive gas, it protects the filament from burning as well as increases the lifetime of the filament. Thin glass is used to manufacture the bulb, preventing the air from reaching the filament to protect it from burning. **Hence statement 2 is correct.**
  - When electric power is passed through the bulb, it reaches the filament through copper and lead wires. The base holds the bulb upright and connects to the electric circuit.
  - Copper and lead wires let the electricity pass from the base to the tungsten filament. It causes the filament to emit light and glow.

Q 73.B

- **The first-ever joint exercise between the special forces of the Indian Army and the Egyptian Army named "Exercise Cyclone-I"** is in progress at Jaisalmer in Rajasthan since 14 January 2023.
- Exercise "Cyclone - I" is the first exercise of its kind bringing the special forces of both nations on a common platform. **The 14 day long exercise which is being carried out in the deserts of Rajasthan engages both the contingents to advance special forces skills such as Sniping, Combat Free Fall, Reconnaissance, Surveillance & Target Designation, sharing of information on weapons, equipment, innovations, tactics, techniques & procedures.**
- The participants would also undertake joint planning and drills for Special Forces operations in a mechanized warfare setting as well as surgical strikes on terrorist camps/hideouts to include sniping of High-Value Targets.
- The joint exercise would **provide an insight into the culture and ethos of both armies thereby fostering military cooperation and interoperability** to further strengthen the diplomatic relations between India and Egypt.
- **Hence, option (b) is the correct answer.**

Q 74.A

- Green crackers are dubbed as **'eco-friendly' crackers** and are known to cause **less air and noise pollution** as compared to traditional firecrackers. They are not completely pollution-free but are relatively cleaner and safer than regular crackers. The regular crackers produce 160-200 decibels of sound, while the green crackers are limited to about 100-130 decibels. **Hence, statement 1 is correct.**

- Green crackers use alternative chemicals such as **potassium nitrate and aluminum instead of magnesium and barium** as well as **carbon instead of arsenic and other harmful pollutants. Hence, statement 2 is not correct.**

Q 75.C

- The most popular argument regarding the origin of the universe is the Big Bang Theory. It is also called expanding universe hypothesis. The Big Bang Theory considers the following stages in the development of the universe:
  - In the beginning, **all matter forming the universe existed in one place in the form** of a "tiny ball" (singular atom) with an unimaginably small volume, infinite temperature, and infinite density.
  - At the Big Bang the "tiny ball" exploded violently. This led to a huge expansion. It is now generally accepted that the event of the big bang took place 13.7 billion years before the present.
  - **As it grew, some energy was converted into matter.** There was particularly rapid expansion within fractions of a second after the bang. Thereafter, the expansion slowed down. Within the first three minutes of the Big Bang event, the first atom began to form.
  - **As the universe expanded, both the density and temperature dropped.** Within 300,000 years from the Big Bang, the temperature dropped to 4,500 K (Kelvin) and gave rise to atomic matter. The universe became transparent. **Hence option (c) is the correct answer.**
  - The expansion of the universe means an increase in space between the galaxies. With greater evidence becoming available about the expanding universe, the scientific community at present favors the argument of expanding the universe. **The expansion continues even to the present day.**

Q 76.A

- **Recently, the archeological survey of india discovered two 1200-year-old miniature votive stupas at Nalanda Mahavihara in Bihar.**
- **Votive stupas have survived in vast numbers in the Mahabodhi temple compound at Bodhgaya. The form of the stupa, with its distinctive domelike drum, originates in eight cylindrical structures in which the Buddha's relics were placed after his death.**
  - The stupa shape has become associated with the **Buddhist goal of release from the cycles of suffering and rebirth.**
  - In addition to the drum, this stupa has a tiered base and is crowned with a series of stylized umbrellas that symbolize royalty and divine status.
  - Although little is known about the uses of votive shrines and stupas, **the larger ones at Bodhgaya were probably given by visiting kings, while smaller stupas such as this one were offered by monks and lay pilgrims.**
- **Stupa, Sanskrit for heap, is a mound-like (hemispherical) burial structure containing relics of Buddhist monks. E.g. Sanchi Stupa built over Buddha relics.**
- **About Nalanda Mahavihara**
  - It is a UNESCO World Heritage Site with archaeological remains of a monastic and scholastic institution from 3rd century BCE to 13th century CE. Gautam Buddha as well as Mahavira stayed at Nalanda. Other famous scholars at Nalanda Nagarjuna, Dharampala, Dinnaga, Jinamitra Santaraksita etc. Imminent pilgrim monks like Hiuen Tsang and I-tsing also visited.
- **Hence, option (a) is the correct answer.**

Q 77.C

- **Recently, as per the study of PricewaterhouseCoopers (PwC) and Association of Microfinance Institutions of India, Microfinance institutions (MFIs) will play a leading role in India's economic growth. MFIs offered credit to around 6 crore borrowers, from low-income households, in the last few years.**
- Microfinance is a form of financial service which provides small loans and other financial services to poor and low-income households. **Malegam Committee (2011) helped establish microfinance as a legitimate asset class.** It is an economic tool designed to promote financial inclusion which enables the poor and low-income households to come out of poverty, increase their income levels and improve overall living standards.
  - It can facilitate achievement of national policies that target poverty reduction, women empowerment, assistance to vulnerable groups, and improvement in the standards of living. Indian microfinance sector has witnessed phenomenal growth over past two decades in terms of increase in both the number of institutions providing microfinance as also the quantum of credit made available to the microfinance customers.

- **Microcredit is delivered through a variety of institutional channels viz., (i) scheduled commercial banks (SCBs) (including small finance banks (SFBs) and regional rural banks (RRBs)) lending both directly as well as through business correspondents (BCs) and self-help groups (SHGs), (ii) cooperative banks, (iii) non-banking financial companies (NBFCs), and (iv) microfinance institutions (MFIs) registered as NBFCs as well as in other forms.**

- **Hence, option (c) is the correct answer.**

Q 78.D

- **Concave mirror:** A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the center of the sphere, is called a concave mirror. Concave mirrors are commonly used in torches, searchlights, and vehicle headlights to get powerful parallel beams of light. They are often used as shaving mirrors to see a larger image of the face. Dentists use concave mirrors to see large images of the teeth of patients. Large concave mirrors are used to concentrate sunlight to **produce heat in solar furnaces**. **Hence pair 3 is correctly matched.**
- **Convex mirror**: A spherical mirror whose reflecting surface is curved outwards, is called a convex mirror. Convex mirrors are commonly used as **rear-view (wing) mirrors** in vehicles. These mirrors are fitted on the sides of the vehicle, enabling the driver to see traffic behind him/her to facilitate safe driving. **Convex mirrors are preferred because they always give an erect, though diminished, image. Also, they have a wider field of view as they are curved outwards**. Thus, convex mirrors enable the driver to view a much larger area than would be possible with a plane mirror. **Hence pair 4 is correctly matched.**
- **Convex Lens:** A lens that has two spherical surfaces, bulging outwards. Such a lens is called a double convex lens. It is simply called a convex lens. It is thicker in the middle as compared to the edges. Convex lens converges light rays. Convex lenses are used to ---
  - Correct farsightedness.
  - Magnifying glasses
  - Multijunction solar cell
  - Microscope
  - **Hence pair 2 is correctly matched.**
- **Concave Lens:** A lens that is bounded by two spherical surfaces, curved inwards is called a double concave lens or simply called a concave lens. It is thicker at the edges than at the middle. Such lenses diverge light rays. So it is also called diverging lenses. Concave lenses are used to ---
  - Correct Nearsightedness.
  - Peepholes
  - Flashlight
  - Camera
  - **Hence pair 1 is correctly matched.**

Q 79.A

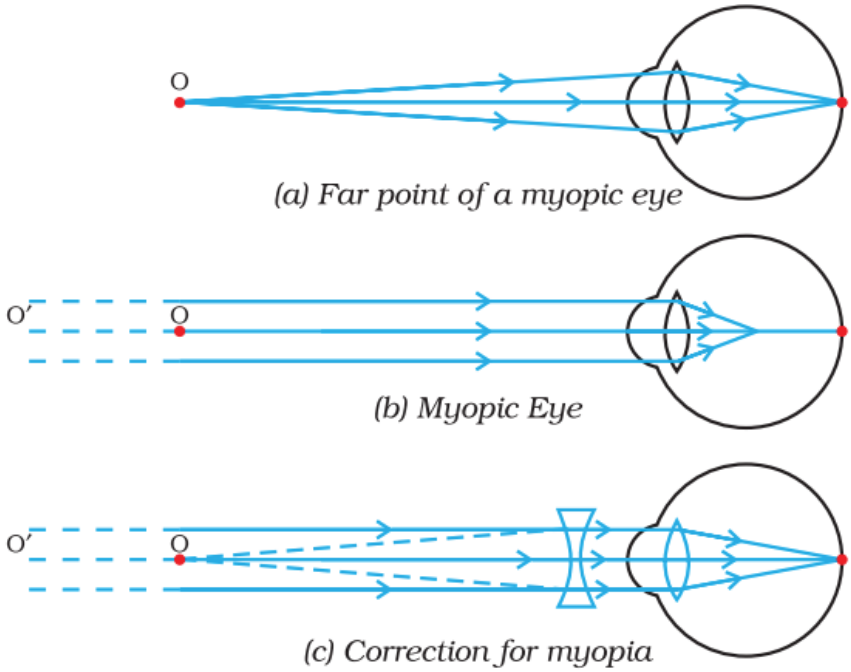
- **Colloidal solutions** are mixtures in which microscopically dispersed insoluble particles of one substance are suspended in another substance.
- **Properties of colloid:**
  - A colloid is a **heterogeneous** mixture.
  - The **size of the particles of a colloid is too small** to be individually seen by the naked eye.
  - Colloids are **big enough to scatter a beam of light** passing through it and make its path visible.
  - They do not settle down when left undisturbed, that is, a **colloid is quite stable.**
- **Cow Milk, milk of magnesia, blood, and shaving cream** are examples of **colloidal solutions.**
- **Tincture of iodine** is an example of a **homogeneous solution** with iodine (solid) as the solute and alcohol (liquid) as the solvent.
- **Hence, option (a) is the correct answer.**

Q 80.C

- Myopia is also known as near-sightedness.
- A person with myopia **can see nearby objects** clearly but cannot see distant objects distinctly. **Hence statement 1 is not correct.**
- A person with this defect has the far point nearer than infinity.
- Such a person may see clearly up to a distance of a few meters.
- In a myopic eye, the image of a distant object is formed in front of the retina and not at the retina itself.

www.iasupscmaterials.org

- This defect can be corrected by using a concave lens of suitable power. **Hence statement 3 is correct**.
- A concave lens of suitable power will bring the image back onto the retina and thus the defect is corrected.
- This defect may arise due to ----
  (i) excessive curvature of the eye lens, or
  (ii) elongation of the eyeball. **Hence statement 2 is correct.**



Q 81.C

- **Hand-foot-and-mouth disease is a mild, contagious viral infection common in young children.**
- **Symptoms include** sores in the mouth and a rash on the hands and feet. it is a mild, self-limiting disease with no significant adverse effects. It lasts seven to ten days.
  - **It spreads by physical contact, sneezing, or by coming in contact with the stool of the infected child. While children below five years of age are prone to be affected by it, teenagers and adults have also been infected by the same. The infection can affect people of all ages but it usually occurs in children under the age of five.**
  - Hand-foot-and-mouth disease is most commonly caused by a coxsackievirus. **This virus is part of a group of viruses called enteroviruses**. In some cases, other types of enteroviruses can cause HFMD.
  - An **increase in cases of hand-foot-and-mouth disease (HFMD) has been reported in Delhi-NCR in 2022.**
  - **There's no specific treatment for hand-foot-and-mouth disease.** Frequent hand-washing and avoiding close contact with people who have hand-foot-and-mouth disease may help lower your child's risk of infection.
  - Hand, foot, and mouth disease is **often confused with foot-and-mouth disease (also called hoof-and-mouth disease), which affects cows, sheep, and pigs. Hence, statement 1 is correct.**
  - Humans do not get the animal disease, and animals do not get the human disease.
  - **Foot-and-mouth disease (FMD) or hoof-and-mouth disease (HMD) is an infectious and sometimes fatal viral disease that affects cloven-hoofed animals, including domestic and wild bovids. The virus causes a high fever lasting two to six days, followed by blisters inside the mouth and near the hoof that may rupture and cause lameness.**
  - **FMD has very severe implications for animal farming,** since it is highly infectious and can be spread by infected animals comparatively easily through contact with contaminated farming equipment, vehicles, clothing, and feed, and by domestic and wild predators.
  - **Humans are only extremely rarely infected by foot-and-mouth disease virus (FMDV).**
  - **Tomato Flu is caused by Coxsackievirus A16. Once infected, the virus produces red and painful blisters on the skin, hence referred to as "Tomato Flu" or "Tomato Fever".** Tomato flu has been reported from at least four states — Kerala, Tamil Nadu, Haryana, and Odisha.

www.visionias.in

- Researchers believe that **it is a different clinical presentation of hand-foot-and mouth disease (HFMD) caused by a group of enteroviruses (viruses transmitted through the intestine). Hence, statement 2 is correct.**
- Tomato flu or tomato fever is characterised by fever, joint pain, and red, tomato-like rashes usually seen in children below the age of five years. **This is accompanied by other symptoms of viral fevers such as diarrhoea, dehydration, nausea and vomiting, and fatigue.**

Q 82.C

- **Recently, FSSAI has released a survey that 15% of dietary supplements are of substandard quality. The Consumer Protection Act 2019 bans misleading advertisements** about any product or service falsely describing a product and deliberately concealing information on sugar content while focusing on immunity boost.
- The **Food Safety and Standards Authority of India (FSSAI) has been established under Food Safety and Standards Act, 2006** which consolidates various acts & orders that have hitherto handled food related issues in various Ministries and Departments.
- **It is an autnomous statutory body which regulates and monitor manufacturing, distrbution and processing of food products. Hence, statement 1 is correct.**
- FSSAI has been created for **laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.**
- Highlights of the **Food Safety and Standard Act, 2006**
  - Various central Acts like Prevention of Food Adulteration Act,1954,Fruit Products Order , 1955, Meat Food Products Order,1973,Vegetable Oil Products (Control) Order, 1947,Edible Oils Packaging (Regulation)Order 1988, Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967, Milk and Milk Products Order, 1992 etc will be repealed after commencement of FSS Act, 2006.
    - **Ministry of Health & Family Welfare,** Government of India is the Administrative Ministry for the implementation of FSSAI. **Hence, statement 2 is correct.**
    - The Chairperson and Chief Executive Officer of Food Safety and Standards Authority of India (FSSAI) have already been appointed by Government of India. **The Chairperson is in the rank of Secretary to Government of India.**

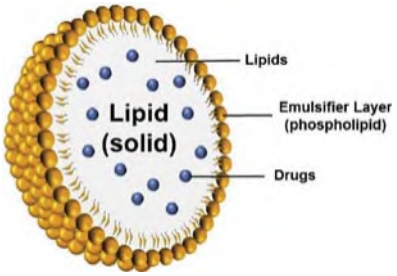
Q 83.A

- Viscosity, the resistance of a fluid (liquid or gas) to a change in shape, or movement of neighboring portions relative to one another. Viscosity denotes opposition to flow.
- The viscosity of honey lies between 0.421 and 23.405 Pa s and the viscosity of water lies between 0.01 poise or 10-3 Pa.s. **Hence option (a) is the correct answer.**
- The reciprocal of the viscosity is called fluidity, a measure of the ease of flow.
- **Honey**, for example, has a greater viscosity than water.
- Because part of a fluid that is forced to move carries along to some extent adjacent parts, the viscosity may be thought of as internal friction between the molecules; such friction opposes the development of velocity differences within a fluid.
- Viscosity is a major factor in determining the forces that must be overcome when fluids are used in lubrication and transported in pipelines. It controls the liquid flow in such processes as spraying, injection molding, and surface coating.
- Honey while more viscous than water, doesn't have higher surface tension than water. Mosquitoes are able to stand on water but slowly sink into honey.
- The densities of
  - Honey is 1360 kg / m3
  - Sugar Syrup is 1320 kg/m3
  - Dishwashing Liquid is 1120 kg / m3
  - Water is 1000 kg / m3.

Q 84.D

- **Solid Lipid Nanoparticles (SLNs)** are examples of lipid-based drug delivery systems that have distinctive properties such as **high drug loading, and large surface area and can protect the drug from the environment** while increasing its bioavailability.
- An SLN is generally **spherical in shape and consists of a solid lipid core stabilized by a surfactant.** The core lipids can be fatty acids, acylglycerols, waxes, and mixtures of these surfactants. Biological membrane

lipids such as phospholipids, sphingomyelins, bile salts (sodium taurocholate), and sterols (cholesterol) are utilized as stabilizers.



- SLNs use **physiological lipids** which **reduces the danger of acute and chronic bio toxicity. Hence, statement 1 is not correct.**
- Some **COVID-19 vaccines (Pfizer-BionTech and Moderna)** that use RNA vaccine technology **coat the fragile mRNA strands with Solid lipid nanoparticles as their delivery vehicle. Hence, statement 2 is not correct.**

Q 85.D

- **Recently, Godavari estuary in Andhra Pradesh has become prime habitat for Indian Skimmer.**
- The Indian skimmer or Indian scissors-bill (Rynchops albicollis) is one of the three species that belong to the skimmer genus Rynchops in the family Laridae.
- **Distribution:**
  - More widespread in winter, the Indian skimmer is found in the coastal estuaries of western and eastern India. **It occurs primarily on larger, sandy, lowland rivers, around lakes and adjacent marshes and, in the non-breeding season, in estuaries and coasts. Hence, statement 1 is correct.**
  - It breeds colonially on large, exposed sand-bars and islands. Colonies of mating pairs can be observed nesting on sandy islands or open sand banks, often accompanied by other birds like Terns during the breeding season, between February and May. **It has breeding colonies in Chambal river, Rajasthan. Hence, statement 3 is correct.**
- **Major Threats:**
  - **The damming of the Chambal River, in upstream Rajasthan, has adversely affected its population at National Chambal Sanctuary, Uttar Pradesh**, due to the dropping water levels allowing predators and livestock access to breeding islands.
  - Predation by corvids like House crows, presence of stray and domestic dogs, have been known to decimate breeding colonies.
- **IUCN status: Endangered. Hence, statement 2 is not correct.**

Q 86.D

- **The third law of motion or Newton's third law of motion states** that when one exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction. These forces act on different objects and never on the same object.
- Launching a rocket relies on Newton's Third Law of Motion. A rocket engine produces thrust through action and reaction. The engine produces hot exhaust gases which flow out of the back of the engine. In reaction, a thrusting force is produced in the opposite reaction**. Hence option 1 is correct.**
- When a fish swims, it pushes the water in opposite direction with its fins in which it wants to move. **Hence option 2 is correct.**
- When a gun is fired, it exerts a forward force on the bullet. The bullet exerts an equal and opposite reaction force on the gun. This results in the recoil of the gun Since the gun has a much greater mass than the bullet, the acceleration of the gun is much less than the acceleration of the bullet. **Hence option 3 is correct.**

Q 87.D

- **Recently, the Supreme Court (SC) held that charge sheet by probing agency is not a "public document". It stated that putting it in public domain will violate the rights of victim, accused and investigating agencies.** SC said that If all the chargesheets and relevant documents produced along with the chargesheets are put on the public domain or the websites of the state governments, it will be contrary to the scheme of the Code of Criminal Procedure (CrPC).
- **Charge sheet refers to a formal police record showing the names of each person brought into custody, the nature of the accusations, and the identity of the accusers. Hence, statement 1 is not correct.** It is also known as four-part charging instrument containing:

- **Information about the accused and the witnesses;**
- the charges and specifications;
- the preferring of charges and their referral to a summary;
- For the trial record.

- **First Information Report (FIR) is a written document prepared by the police when they receive information about the commission of a cognizable offence.** Based on information so provided the investigation started. F.I.R can also be registered by the Judicial Magistrate by giving the direction to the concerned jurisdictional area of the Police Station.Evidentiary value of F.I.R is that F.I.R is not substantive evidence in nature. But It can be used as corroborative or contradictory evidence. **Hence, statement 2 is not correct.**
- **A charge sheet is distinct from the First Information Report (FIR), which is the core document that describes a crime that has been committed. It usually refers to one or more FIRs and charges an individual or organization for (some or all of) the crimes specified in those FIR(s). Once the charge sheet has been submitted to a court of law, prosecution proceedings against the accused begin in the judicial system.**
- Under **Youth Bar Association Case (2016**) the SC issued directions to the police to upload the FIRs in website within 24 hours except in sensitive cases like rape.
- SC said that Putting the FIR on the website cannot be equated with putting the chargesheets along with the relevant documents on the public domain and the websites of the state governments.

Q 88.C

- **Recent Context:** At least 70 samples of commonly used drugs were found to be of sub-standard quality by the Central Drugs Standard Control Organization (CDSCO) after the latest round of inspections.
- **CDSCO is under Directorate General of Health Services, Ministry of Health & Family Welfare. Hence statement 2 is correct.**
- **It is the Central Drug Authority for discharging functions assigned to Central Government under the Drugs and Cosmetics Act, 1940.**
- Under Drugs and Cosmetics Act, CDSCO is responsible for:
  - **Approval of Drugs, Conduct of Clinical Trials,** Laying down standards for Drugs, and Control over quality of imported Drugs in country. **Hence statement 1 is correct.**
  - Coordination of activities of State Drug Control Organizations by providing expert advice.

Q 89.D

- The atomic model also called as 'Nuclear Model' was devised by Ernest Rutherford who was an English physicist and an accomplished experimentalist. Ernest Rutherford was interested in knowing how the electrons are arranged within an atom. Rutherford designed an experiment for this. In this experiment, fast-moving alpha (α)-particles were made to fall on a thin gold foil.
- The α-particle scattering experiment gave totally unexpected results. The following observations were made:
  - Most of the fast-moving α-particles passed straight through the gold foil.
  - Some of the α-particles were deflected by the foil by small angles.
  - Surprisingly one out of every 12000 particles appeared to rebound.
- Rutherford concluded from the α-particle scattering experiment that
  - Most of the space inside the atom is empty because most of the α-particles passed through the gold foil without getting deflected.
  - Very few particles were deflected from their path, indicating that the positive charge of the atom occupies very little space.
  - A very small fraction of α-particles were deflected by 1800, indicating that all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.
- **On the basis of his experiment, Rutherford put forward the nuclear model of an atom. Rutherford's atomic model, nuclear atom, or planetary model of the atom, provides a description of the structure of atoms.** The model described the atom as a tiny, dense, positively charged core called a nucleus, in which nearly all the mass is concentrated, around which the light, negative constituents, called electrons, circulate at some distance, much like planets revolving around the Sun.
- Electrons were discovered by J.J. Thomson in 1897. J.J. Thomson's cathode ray tube experiment discovered the subatomic particle the electron.

www.upscmaterials.org

- Eugene Goldstein discovered positive particles by using a tube filled with hydrogen gas (this tube was similar to Thomson's tube). This resulted in The positive particle had a charge equal to and opposite to the electron. The positive particle was named the proton.
- British physicist Sir James Chadwick discovered neutrons in the year 1932. James Chadwick conducted an experiment in which he bombarded Beryllium with alpha particles from the natural radioactive decay of Polonium. The resulting radiation showed high penetration through a lead shield, which could not be explained via the particles known at that time.
- **Hence option (d) is the correct answer.**

Q 90.B

- Organisms that can cause disease are found in a wide range of such categories of classification. Some of them are viruses, some are bacteria, some are fungi, some are single-celled animals or protozoans. Some diseases are also caused by multicellular organisms, such as worms of different kinds.
- **Disease caused by Bacteria:**
  - Whooping Cough - It is caused by a bacterium called Bordetella pertussis.
  - Diphtheria - It is caused by Corynebacterium diphtheriae.
  - Cholera - It is caused by Vibrio cholera.
  - Leprosy - It is caused by Mycobacterium leprae.
  - Pneumonia- It is caused by Streptococcus pneumonia.
  - Tetanus - It is caused by Clostridium tetani.
  - Typhoid - It is caused by Salmonella typhi.
  - **Tuberculosis - It is caused by Mycobacterium tuberculosis.**
  - Plague - It is caused by Yersinia pestis.
- **Disease Caused by Protozoans:**
  - Diarrhoea: There are a number of intestinal protozoa that cause diarrhea, but Entamoeba histolytica, Giardia intestinalis and Cryptosporidium species are the most important causes of diarrhea
  - **Malaria: It is spread by Anopheles mosquitoes. The Plasmodium parasite that causes malaria is neither a virus nor a bacteria.**
  - Amoebic dysentery: It is caused by Entamoebahistolytica.
  - Sleeping sickness: It is caused by Trypanosomabrucei.
  - **Kala-azar It is caused by Leishmaniadonovani.**
- **Disease Caused by Worms:**
  - Tapeworm: They are intestinal parasites. It cannot live on its own. It survives within the intestine of an animal including a human.
  - Pinworm: It is caused by a small, thin, white roundworm called Enterobiusvermicularis.
- **Disease caused by Viruses:**
  - Chickenpox - It is caused by the Varicella-zoster virus.
  - Small Pox - It is caused by the Variola virus.Common Cold -It is caused by Rhinovirus.
  - AIDS (Acquired Immuno Deficiency Syndrome) - It is caused by Human Immunodeficiency Virus (HIV).
  - Measles -It is caused by the Measles virus.
  - Mumps -It is caused by the Mumps virus.
  - Rabies - It is caused by the Rabies virus (Rhabdoviridae family).
  - **Dengue fever -It is caused by the Dengue virus.**
  - Viral encephalitis - It is an inflammation of the brain. It is caused by the rabies virus, Herpes simplex, poliovirus, measles virus, and JC virus.
- **Hence, option (b) is the correct answer.**

Q 91.D

- Trans fat is considered the worst type of fat to eat.
- **A diet laden with trans fats increases the risk of heart disease, the leading killer of adults. The more trans fats eaten, the greater the risk of heart and blood vessel disease.**
- **Most trans fats are formed through an industrial process that adds hydrogen to vegetable oil, which causes the oil to become solid at room temperature.**
- **This partially hydrogenated oil is inexpensive and less likely to spoil, so foods made with it have a longer shelf life. Some restaurants use partially hydrogenated vegetable oil in their deep fryers, because it doesn't have to be changed as often as do other oils.**
- **There are two main types of cholesterol:**

www.upscmaterials.org

- **Low-density lipoprotein (LDL) cholesterol.** LDL, or "bad," cholesterol can build up in the walls of arteries, making them hard and narrow.
- **High-density lipoprotein (HDL) cholesterol.** HDL, or "good," cholesterol picks up excess cholesterol and takes it back to the liver.

- **Trans fats increase LDL cholesterol and decrease HDL cholesterol, which can increase the risk of heart attack or stroke. Hence, statement 1 is correct.**
- **Kerala is the first state in India to introduce a "fat tax" on burgers, pizzas, doughnuts and tacos served in branded restaurants. Hence, statement 3 is not correct.**
- Kerala has the most number of people suffering from obesity after the northern state of Punjab in India, according to a national family health survey. With increasing affluence, lifestyle diseases are on the rise and the government aims to check this with the fat tax.
- **The World Health Organization (WHO) has launched a comprehensive plan REPLACE to eliminate industrially-produced artificial trans fats from the global food supply by 2023. Hence, statement 2 is correct.**
- Elimination of trans fats is key to protecting health and saving lives, the WHO said. The global health body estimates that every year, trans fat intake leads to over 5,00,000 deaths worldwide from cardiovascular diseases.
- Industrially-produced trans fats are contained in hardened vegetable fats such as margarine and and ghee, and are often present in snack, baked, and fried foods.
- **REPLACE provides six strategic actions to ensure the prompt, complete, and sustained elimination of industrially-produced trans fats from the food supply:**
  - **REview** dietary sources of industrially-produced trans fats and the landscape for required policy change.
  - **Promote** the replacement of industrially-produced trans fats with healthier fats and oils.
  - **Legislate** or enact regulatory actions to eliminate industrially-produced trans fats.
  - **Assess** and monitor trans fats content in the food supply and changes in trans fat consumption in the population.
  - **Create** awareness of the negative health impact of trans fats among policymakers, producers, suppliers, and the public.
  - **Enforce** compliance of policies and regulations.

Q 92.C

- **Archaeological panel is about to begin excavation at Delhi's Purana Qila to trace 'Mahabharata' evidence. The ASI will begin excavation to trace the Painted Grey Ware period (c. 600–1000 BCE), commonly known as the 'Mahabharata' period.**
- The objective of the excavation, as per the Archaeological Survey of India, is the preservation of the trenches that were excavated between the years 2013-14 and 2017-18.
- **Purana Qila was built by Mughal Emperor Humayun as a part of his new city of Dinpanah in the 16th century. Apart from archaeology, textual sources such as Ain-i-Akbari of Abul Fazal (16th century), mention that fort was built at site of Indraprastha.**
- **Architectural features of Purana Qila Complex**
  - **Qila-e-Kuhna mosque:** Built by Sher Shah. It reflects a transitional stage between architecture of Lodhis and Mughals.
  - **Sher Mandal:** Built by Sher Shah, an octagonal structure built in red sandstone and decorated with white and black marble inlay. Humayun made it into a library and died after falling from the steps of this structure.
  - **A Baoli** for managing water supply and a hammam (bathhouse) is present. Lal Darwaza and Khairul Manazil are considered part of this complex.
  - **Three majestic Gateways: Bada Darwaja, Humayun Darwaza, and Talaqi Darwaza.**
  - **Hence, option (c) is the correct answer.**

Q 93.D

- Photosynthesis is the **process by which green plants and certain other organisms transform light energy into chemical energy.** During photosynthesis in green plants, light energy is captured and used to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds.
- **Respiration in plants refers to a process in which a plant utilizes atmospheric oxygen to oxidize glucose and other respiratory substrates like fats or proteins.**
- The relationship between photosynthesis and cellular respiration is such that the products of one system are the reactants of the other.

- **Photosynthesis involves the use of energy from sunlight, water and carbon dioxide to produce glucose and oxygen.**
- **Cellular respiration uses glucose and oxygen to produce carbon dioxide and water. Hence statement 3 is not correct.**
- Humans, animals and plants depend on the cycle of cellular respiration and photosynthesis for survival. The oxygen produced by plants during photosynthesis is what humans and animals inhale for the blood to transport to the cells for respiration.
- The carbon dioxide produced during respiration is released from the body and absorbed by plants to help provide the energy they need for growth and development. This is the never ending cycle that sustains life on earth.
- **Photosynthesis is an endothermic reaction because sunlight energy is absorbed during the process of photosynthesis by the plants.**
- **Respiration is a kind of burning fuel. During respiration, Carbohydrates present in food are broken down to form glucose. Glucose combines with oxygen in the cells of our body and provides energy. Therefore, respiration is an exothermic reaction. Hence statement 1 is not correct.**

Photosynthesis	Respiration
1) Occurs only in plants and some photosynthetic bacteria.	1) Occurs in all living organisms.
2) Takes place in the presence of sunlight.	2) Takes place throughout the day.
3) It occurs in chloroplast and is dependent on light.	3) Aerobic respiration occurs in cytoplasm and mitochondria and is independent of light.
4) Raw materials are CO_2 and water.	4) Uses carbohydrates or organic substances and oxygen.
5) In this process light energy is fixed in the form of chemical energy and stored in carbohydrates.	5) In this process chemical energy stored in the carbohydrates burns to release energy.
6) Oxygen is liberated in this process and carbon dioxide is utilized.	6) Oxygen is utilized and carbon dioxide is released.

- **Hence statement 2 is not correct.**

Q 94.D

- **Recently, India Meteorological Department (IMD) declared that it will cover entire India under a Doppler Weather Radars (DWRs) network by 2025. DWRs are used to locate precipitation, calculate its motion, and estimate its type.** A Doppler Radar is a specialized radar that uses the Doppler effect to produce velocity data about objects at a distance.
- Doppler effect in physics is defined as the increase in the frequency of sound, light, or other waves as the source and observer move towards each other. **Also, it is defined as the decrease in the frequency of sound, light, or other waves as the source and observer move away from each other. Hence, statement 1 is correct.**
- **The Doppler effect can be observed for any type of wave - water wave, sound wave, light wave, etc.** We are most familiar with the Doppler effect because of our experiences with sound waves. **For instance, when a police car or emergency vehicle was traveling towards us on the highway and as the car approached with its siren blasting**, the pitch of the siren sound (a measure of the siren's frequency) was high; and then suddenly after the car passed by, the pitch of the siren sound was low. That was the Doppler effect - an apparent shift in frequency for a sound wave produced by a moving source. **Hence, statement 2 is correct.**
- **The Doppler red shift of light observed from distant stars and galaxies gives evidence that the universe is expanding (moving away from a central point).** This allows for Big Bang Theory, because after a "bang" occurs all of the matter moves away from the point of origin. **Hence, statement 3 is correct.**

Q 95.D

- **Reverberation:** It is the phenomenon of the persistence of sound after it has been stopped due to multiple reflections from surfaces, such as furniture, people, air, etc., within a closed surface. These reflections build up with each reflection and decay gradually as they are absorbed by the surfaces of objects in the enclosed space. **Hence option (d) is the correct answer.**

- **Pitch:** The pitch of a sound is our ear's response to the frequency of sound. Whereas loudness depends on the energy of the wave. In general, the pitch is the reason behind the difference in voice quality of different individuals.
- **Interference:** When two or more sound waves occupy the same space, they affect one another. The waves do not bounce off of each, but they move through each other. The resulting wave depends on how the waves line up.
- **Echo:** When the sound is repeated when the sound wave is reflected, it is known as an echo. Echo is heard when space is large. Example: imagine standing in an empty room and shouting "Hi".

Q 96.C

- **Sodium benzoate** is an odorless, crystalline powder made by **combining benzoic acid and sodium hydroxide**. Benzoic acid is a good preservative on its own, and combining it with sodium hydroxide helps it dissolve in products. It is also used as a preservative in soft drinks to increase the acidity of flavor. **Hence, statement 1 is correct.**
- Aside from its use in processed foods and beverages, sodium benzoate is also added to some medicines, cosmetics, personal care products, and industrial products.
- While sodium benzoate is considered safe, scientific research has shown that **negative side effects** occur when it's **mixed with ascorbic acid (vitamin C).** Their studies indicate that it then turns into **benzene**, a known carcinogen that may cause cancer. **Hence, statement 2 is correct.**

Q 97.D

- The Autonomic Nervous System: This system governs activities which are normally not under direct control of individuals. It controls such internal functions as breathing, blood circulation, salivation, stomach contraction, and emotional reactions. These activities of the autonomic system are under the control of different structures of the brain.
- The Autonomic Nervous System has two divisions: Sympathetic division and Parasympathetic division. Although the effect of one division is opposite to the effect of the other, both work together to maintain a state of equilibrium.
- **The sympathetic division deals with emergencies when the action must be quick and powerful, such as in situations of fight or flight.** During this period, the digestion stops, blood flows from internal organs to the muscles, and breathing rate, oxygen supply, heart rate, and blood sugar level increases. **Hence statement 1 is not correct.**
- **The Parasympathetic division is mainly concerned with conservation of energy. It monitors the routine functions of the internal system of the body**. When the emergency is over, the parasympathetic division takes over; it decelerates the sympathetic activation and calms down the individual to a normal condition. As a result all body functions like heart beat, breathing, and blood flow return to their normal levels. **Hence statement 2 is not correct.**

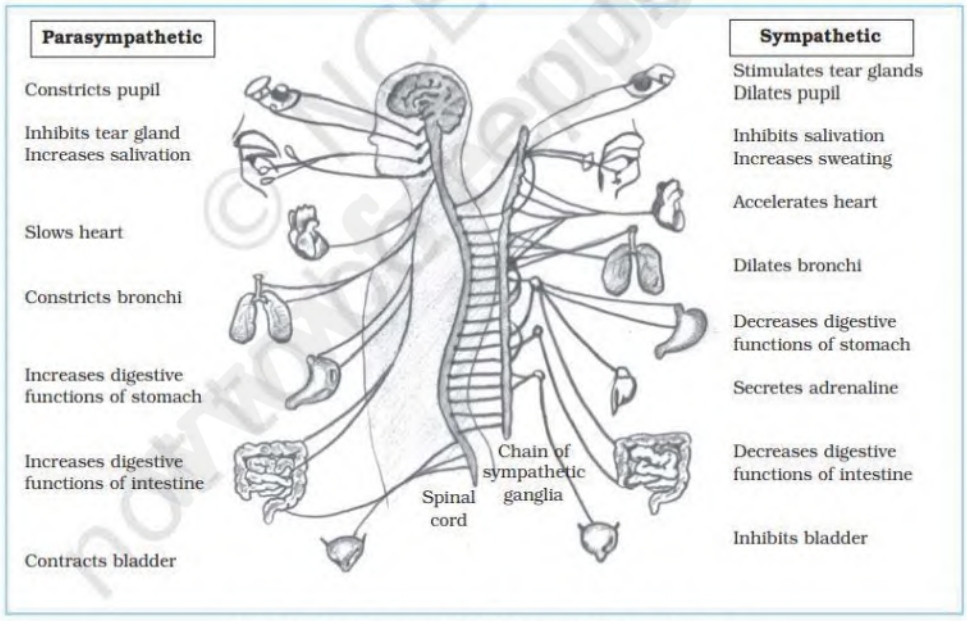


Fig.3.4 : The Functions of the Autonomic Nervous System

Q 98.C

- When a sealed transparent plastic bottle filled with hot air is placed in the freezer, the **plastic bottle will collapse on itself.** The collapsing bottle demonstrates the properties of gasses collectively known as the **Ideal Gas Law**, an equation describing the relationship between temperature, pressure, and volume.
- According to Gas Law, **the pressure and volume are inversely proportional to each other and both are proportional to temperature.** So as the temperature decreased when the bottle filled with hot air is placed inside the freezer, **the pressure decreased until the bottle gave in and collapsed (the volume decreased until the pressure equalized).**
- **Hence, option (c) is the correct answer.**

Q 99.C

- Melting of ice involves a change in the state of water from solid to liquid. Since it involves a change in the state of water without forming any new substance, **it is a physical change.**
- When ice melts, it converts to water and the **density of ice is less than of water**. Hence, **the volume will decrease.**
- Heat is generated by exothermic processes, which raise the temperature of the surrounding environment, endothermic processes absorb heat from the environment and cool it. **Heat is removed from the surrounding atmosphere to melt the ice**, thus, melting of ice requires the use of energy to break the hydrogen bonds in the ice. Consequently, **ice melting is an endothermic process.**
- Melting of ice is **just a change of state from a solid to a liquid** and is still the same amount of water. **It should have the same mass.**
- **Hence, option (c) is the correct answer.**

Q 100.D

- **Blood is a constantly circulating fluid providing the body with nutrition, oxygen, and waste removal.**
- Blood is a special connective tissue consisting of a fluid matrix, plasma, and formed elements.
- **Plasma is the liquid component of blood. Plasma makes up 55% of blood's total volume.**
- **90-92 per cent of plasma is water. The remaining 8 percent of plasma contains several key materials**, including:
    - proteins
    - Immunoglobulins
    - electrolytes
- **Plasma Proteins**
    - **Fibrinogen, globulins and albumins are the major proteins.**
    - **Fibrinogens are needed for clotting or coagulation of blood.** Fibrinogen helps to reduce active bleeding, making it an important part of the blood-clotting process. If a person loses a lot blood, they'll also lose plasma and fibrinogen. This makes it harder for blood to clot, which can lead to significant blood loss. **Hence, statement 1 is correct.**
    - **Globulins primarily are involved in defense mechanisms of the body** and defends our body from infections including bacteria, fungi, viruses and cancer cells. **Hence, statement 2 is correct.**
    - **Albumin help in osmotic balance.** It is vital for maintaining a balance of fluid, called oncotic pressure, in the blood. This pressure is what keeps fluid from leaking into areas of the body and skin where less fluid usually collects. For example, people with low albumin levels may have swelling in their hands, feet, and abdomen. **Hence, statement 3 is correct.**
- **Immunoglobulins**Plasma contains gamma globulins, a type of immunoglobulin. Immunoglobulins help the body fight off infections.
- **Electrolytes**Electrolytes conduct electricity when dissolved in water, hence their name. Common electrolytes include sodium, potassium, magnesium, and calcium. Each of these electrolytes plays a key role in the body.

Copyright © by Vision IAS

All rights are reserved. No part of this document may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission of Vision IAS.